



AGRICULTURAL RESEARCH INSTITUTE
PUSA

BULLETIN OF THE IMPERIAL INSTITUTE

A RECORD OF PROGRESS RELATING TO
AGRICULTURAL, MINERAL AND OTHER
INDUSTRIES, WITH SPECIAL REFERENCE TO
THE UTILISATION OF THE RAW MATERIALS
OF THE DOMINIONS, INDIA AND THE COLONIES



VOL. XLI. 1943

LONDON
IMPERIAL INSTITUTE, SOUTH KENSINGTON,
S.W.7

*Printed in Great Britain by
A. Brown & Sons, Ltd., London and Hull.*

BULLETIN OF THE IMPERIAL INSTITUTE

VOL. XLI. 1943

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Frontispiece

Mary E.

1943.

Frontispiece]



MARLBOROUGH HOUSE
S.W.1.

I have the happiest memories of the opening of the Imperial Institute on the 10th. May, 1893. The Institute was planned by the late King Edward VII, then Prince of Wales, as an abiding memorial of Queen Victoria's Golden Jubilee, and Queen Victoria herself presided at the ceremony and declared the building open. The Institute has since carried out the essential duties with which it was charged by Royal Charter "of facilitating close intercourse between inhabitants of Our Empire and of providing efficient means for the continuous development of its commercial and industrial resources and for the advancement of the commercial and industrial education of Our subjects". I wish the Institute continued success in the important work which it has been called upon to fulfil.

A handwritten signature in black ink, appearing to read "Mary R", is written over a large, sweeping flourish.

10th. May, 1943.

Facsimile of Message from Her Majesty Queen Mary.

BULLETIN OF THE IMPERIAL INSTITUTE

VOL. XLI. NO. 1.

JANUARY-MARCH, 1943

INTRODUCTION

By MR. HARCOURT JOHNSTONE, M.P.,
*Secretary of the Department of Overseas Trade and President of
the Board of Governors of the Imperial Institute*

As President of the Board of Governors of the Imperial Institute I have much pleasure in writing this short introduction to a volume which celebrates, in the manner best suited to war conditions, the fiftieth anniversary of the opening of the Institute by Queen Victoria on May 10, 1893. In peace-time, some public and social celebration would have been possible; in war-time, we must be content with converting the normal quarterly BULLETIN of the Institute into a special number which, in the pages that follow, records the good wishes of our friends, and, later, describes the genesis, the growth and some of the achievements of this all-Empire institution.

The Governors and I are indeed honoured that Queen Mary has been graciously pleased to share in our celebrations of an event in which Her Majesty had taken a personal part. Queen Mary's message and photograph, which adorn the first pages of this volume, greatly encourage us in our efforts on behalf of an Institute which was designed to fulfil high purposes and which our predecessors have passed to us with no mean record of successful and useful progress.

The Institute is unique, perhaps, amongst other all-Empire organisations, in that it combines responsibility for the collection and dissemination of scientific and technical facts bearing on the development of the economic resources of all countries within the British Commonwealth with the spread of knowledge about the life and scenery, the arts and industries, of the Overseas Empire amongst the citizens of the United Kingdom. In this building may thus be found on the one hand the intelligence systems and library where scientific knowledge is kept on record, as well as the laboratories which add fresh facts to the record; and on the other hand the methods and arts of visual instruction by means of which a knowledge of the Overseas Empire assists in developing a consciousness of Empire citizenship.

The Governors and I feel that the Imperial Institute has a great future before it, and we are determined to do all in our power to further its successful evolution on the lines of Empire service so happily laid down for it in the days of its inauguration.

GOOD-WILL MESSAGES TO THE IMPERIAL INSTITUTE

From THE RIGHT HON. VINCENT MASSEY, High Commissioner for Canada.

I welcome this opportunity of sending my very best wishes to the Imperial Institute on the occasion of its fiftieth anniversary.

For half a century the Institute has carried on work of the greatest value in promoting a wider and better knowledge of the great resources of the British Empire. Even through the years of war these activities have been continued as far as was possible, often under conditions of great difficulty.

When peace comes we shall be more than ever appreciative of the efforts of the Institute. These can then be turned to good account in the important years of reconstruction and we shall be able to make full use of the rich fund of information and experience in the field of Empire study which it has accumulated over the years. I wish the Imperial institute continued success in its important work.

From THE HON. WILLIAM J. TUPPER, K.C., Lieutenant-Governor, Manitoba, 1934-1940.

Union Trust Building,
Winnipeg,
Canada.

Dear Sir Harry Lindsay,

It gives me much pleasure to congratulate you and your co-directors of the Imperial Institute on the approaching celebration of the fiftieth anniversary. I know that my father the late Rt. Hon. Sir Charles Tupper, Bart., had the satisfaction of assisting the late Sir P. Cunliffe-Owen in the birth of the Institute. He became a member of the Committee on the organisation of the Imperial Institute in January 1887, and placed the project before Sir John A. Macdonald and the Dominion Government at Ottawa with the result that the Parliament of Canada granted £20,000 to the Imperial, Colonial and Indian Institute as a Memorial of the Jubilee of Queen Victoria's reign. He also secured the hearty co-operation of the Governments of Ontario, Quebec, New Brunswick, Nova Scotia and Prince Edward Island. You will understand how gratified my father would be, if he were alive, to join with you in celebrating the fiftieth anniversary on May 10, 1943. During these fifty years five of the old colonies have grown to full nationhood and the Empire is transformed into a Commonwealth of Free Nations. The Imperial Institute can now devote itself to the happiness and progress of the citizens of the Overseas Empire with special regard to the agricultural, mineral and other industries

and utilisation of the raw materials of the Dominions, India and the Colonies.

In conclusion, may I express the wish that the Institute may continue to achieve even greater triumphs in the future.

With kindest regards,

Yours sincerely,

(signed) WILLIAM J. TUPPER.

From THE RIGHT HON. S. M. BRUCE, C.H., M.C., High Commissioner for Australia.

It gives me great pleasure to offer, on behalf of the Commonwealth of Australia, congratulations to the Imperial Institute on the attainment of its fiftieth anniversary, and for the contribution it has made towards the development of Imperial relations in those vital years.

The exhibitions in the galleries of the Institute have always been a great attraction to visitors to London. Through its lectures the Institute has done, and is doing, a great work in disseminating a knowledge of the Empire throughout the length and breadth of the land; while its scientific and technical departments have, I know, been of the greatest assistance, not only to Australian Government departments, but to firms and individuals throughout the Commonwealth.

The Institute has my sincere wishes for its future success, and for the continued expansion of its work for the Empire in the years that lie ahead.

From MR. W. J. JORDAN, High Commissioner for New Zealand.

New Zealand Government Offices,

415 Strand,

London, W.C.2.

I am happy to associate New Zealand with the congratulations and most cordial good wishes accorded to the Imperial Institute on the fiftieth anniversary of its opening. That span of fifty years has seen great changes in our Empire. Our people in the four corners of the earth have proved their adaptability to changing conditions. What we have been able to do is an augury of what, with goodwill and determination and the co-operative spirit practically applied, we will yet be able to do in improving and making more secure the standards of human existence the world over. In its fifty years the Imperial Institute has rendered great service. It has been a pioneer in extending the frontiers of science and in disseminating the results of research. It has been a clearing-house for the exchange of fruitful information from which we have all benefited.

From THE HON. COLONEL DENEYS REITZ, *High Commissioner for the Union of South Africa.*

SOUTH AFRICA HOUSE,
Trafalgar Square,
London, W.C.2.

My Dear Sir Harry,

May I, through you, send a message of congratulation to the Imperial Institute on attaining its fiftieth anniversary after half a century of immensely important work in spreading a knowledge of our joint Commonwealth among the peoples of the world, and more particularly among the peoples of the Empire?

The fact that every British Dominion and every British Colony contributes to the support of the Institute, in itself proves how greatly its efforts are appreciated, and I am proud to know that my own country has for many years sent in its annual offering of goodwill.

We out yonder realise how much we benefit from the technical and scientific activities carried on within its walls.

As a South African I would like to say, too, how much your African exhibits are admired by every visitor from the Union. Indeed, the panoramas, the models, and the photographs and pictures of South African scenes are so life-like and real as to render us positively homesick for the sunshine and the wide horizons of our own country.

To-day, with the Empire once more facing the powers of darkness, the need for stressing the determination of the free nations of the earth to maintain their liberties intact, becomes greater than ever and the value of the Institute's mission in creating a better understanding of our aims and ideals becomes the more important.

As one who served under arms against the British Empire in times gone by, I have come to see that the Empire with all its faults is the main bastion of European liberty, and if it were to go down before its enemies we should be plunged back into the dark ages once more.

Therefore, a long life to the Imperial Institute! May it flourish and prosper and continue to strengthen the bonds between the Imperial lands and between the free nations of the earth.

May I, in conclusion, say that the half-centenary of the Institute is of personal interest to me, because as a boy of twelve I was shown over it by that great Proconsul, Sir George Grey, in 1894, less than a year after it had been inaugurated by Queen Victoria. The impressions I gained at the time are still a living memory.

Yours sincerely,

(Signed) DENEYS REITZ.

From KHAN BAHADUR SIR M. AZIZUL HUQUE, C.I.E., D.Litt., High Commissioner for India and Burma.

On the occasion of the fiftieth anniversary of the opening of the Imperial Institute, I offer my sincere congratulations to those who have carried on the great traditions of the Institute. It has played a great part in the development of the Empire. The Institute's Scientific and Technical Department, which has always been available to the various Governments and the business community has, in no small way, contributed to this development. Apart from the economic and development side of the work, the Institute has in recent years taken various measures to instil into the minds of the younger generation the wonders of the British Commonwealth and what it has to offer. Many of these may, at some future date, find a field of development in which they can usefully assist some of the younger people of the world.

The Indian Gallery at the Institute brings to the notice of visitors India's great agricultural and mineral resources, her arts and crafts, her modern large-scale industries and the many other features which illustrate the great part which she has played, and still plays, in the Commonwealth of Nations.

Most sincerely I wish the Imperial Institute continued success in its great work for the future benefit of mankind.

From MR. S. M. L. O'KEEFFE, C.M.G., High Commissioner for Southern Rhodesia.

Greetings and congratulations from Southern Rhodesia to the Imperial Institute are truly fraternal for, as far as it is possible for such entities to have a definite birthday, the Institute and Southern Rhodesia are twins.

When the Institute was founded Cecil Rhodes was laying the foundation stones of a State that had hitherto existed only in his splendid dreams. While the Institute was building the Pioneer Column was carrying the Union Jack into a fair country still steeped in barbarism. On the selfsame day that, fifty years ago, the Institute was formerly opened the first sod was cut on the railway that was to link Rhodesia (then called Zambesia) to its sister British States and open it to the civilised world.

All this, though more than mere coincidence, would be of minor interest had it not also been that the Imperial Institute had, from time to time, been of invaluable service to Rhodesia in giving advice upon scientific, industrial and commercial problems and also in making her existence and potentialities more generally known.

From MR. D. J. DAVIES, C.B.E., J.P., B.Sc., F.I.C., Trade Commissioner for Newfoundland.

58 Victoria Street,
Westminster, S.W.1.

Dear Sir Harry,

I should like to thank you for giving me this opportunity to congratulate you and your staff on the occasion of the Golden Jubilee of the Imperial Institute.

I have been in touch with the Institute for the past twenty-three years, and during that time I have been much impressed with its many and varied activities.

The galleries provide a splendid Empire Exhibition in the heart of London and a great number of Newfoundland service men in this country have derived much pleasure and profit by their visits to them.

In its fiftieth year, the Institute is younger and more active than at any other time in its career, and I wish it many more years of valued service and prosperity.

Yours sincerely,

(Signed) D. JAMES DAVIES,
Trade Commissioner for Newfoundland.

From MR. G. H. CREALY, C.M.G., O.B.E., Assistant Secretary, Colonial Office, and representative of the Secretary of State for the Colonies on the Board of Governors of the Imperial Institute.

Colonial Office,
Downing Street,
S.W.1.

My dear Lindsay,

Colonel Oliver Stanley has asked me, as one of his representatives on the Board of Governors, to send you, on behalf of the Colonial Office, a message of congratulation on the fiftieth anniversary of the opening of the Imperial Institute.

During the last half century there have been enormous developments in the Colonial Empire, and it would be difficult to exaggerate the contribution which the Institute has made to those developments. But the present anniversary is merely one milestone on the road which will, we are confident, lead to a still more glorious future both for the Colonial Empire and for the Institute. In that future we shall look with confidence to the Institute for help in many ways. Its scientific and technical departments will help Colonial Governments and producers to determine the value and uses of

Colonial products, and to find markets for them. Its galleries will make better known to your visitors the story of the Colonial Empire, and give them a feeling of legitimate pride in our past achievements and a more serious interest in our present problems. And the extension work of its lecturers and the films which it distributes will help to make this history and these problems known to even wider circles, particularly of school children, who cannot visit the Institute in person.

We wish the Institute long life and every success in its undertakings.

Yours sincerely,

(Signed) GERALD CREASY.

From SIR EDWARD ROSLING, for ten years unofficial member of the Legislative Council of Ceylon.

The Institute has reached its jubilee and in the short fifty years of its existence it has become the centre for the dissemination of information in regard to the vegetable and mineral products of the Empire. One of its most useful works was in connection with the early days of plantation rubber and its manufacturing processes. That, however, was only one product. In addition much consideration was given to such different commodities as quinine and sisal hemp.

To touch on the many different interests and the useful work done would, I am afraid, more than fill the BULLETIN, but one can say that, as the central bureau of knowledge on all Empire products, the name of "Imperial Institute" is more than justified.

From LADY DAVSON, O.B.E., West India Committee.

The West India Committee,
War Services,
40 Norfolk Street,
London, W.C.2.

Dear Sir Harry,

As you are aware, through my husband's work both on the Imperial Economic Committee and on the Empire Marketing Board, I have been very familiar with the work of the Imperial Institute for many years. I know the value which he attached not only to the educational side, but to the scientific advisory work which has done so much to promote the development and improvement of products coming from the Empire. On the educational side the galleries, with their attractive dioramas, have helped to

stimulate the interest in knowledge of the Empire which is so well carried on by the films shown, and now by the greatly extended scope of the lectures to schools.

In appreciation of the part the Institute has played and will continue to play may I therefore send you these few words of good wishes on the occasion of the fiftieth anniversary of its opening by Her Majesty Queen Victoria.

Yours sincerely,

(Signed) MARGOT DAVSON.

From MAJOR E. J. LUGARD, D.S.O., O.B.E., Political Service, Nigeria, 1903-06 and 1912-15; Secretary, Imperial Institute, 1908-12.

The Director has invited me to send a short message of goodwill on the occasion of the Jubilee of the Imperial Institute. From 1908 to 1912 I had the honour to serve as Secretary to the Imperial Institute under Sir Wyndham Dunstan, and I then fully learnt its immense value to the Empire, both in scientific research and in the educative effect of the splendid representative galleries.

Since those days the Imperial Institute has advanced a very long way, and its mission is more vital than ever, when the closer unity of the Commonwealth and the welfare and development of our Colonial Empire are the most pressing problems of to-day.

From SIR WYNDHAM DUNSTAN, K.C.M.G., M.A., LL.D., F.R.S., Director of the Scientific and Technical Department, Imperial Institute, 1896-1903; Director of the Imperial Institute, 1903-1924.

On looking back over the fifty eventful years of the Imperial Institute's life it is fitting that one who was associated during nearly thirty of those years with the Institute and who was the second to fill the office of Director in 1903, and who carried out an entire reconstruction, should offer hearty congratulations to all those now connected with it on its present strength and usefulness to the Empire, and also express the hope and belief that future years will offer still greater opportunities for service in the New World which is to come.

From LIEUT.-GENERAL SIR WILLIAM FURSE, K.C.B., K.C.M.G., D.S.O., Director of the Imperial Institute, 1926-34.

Sir Harry Lindsay has asked me to send him a message of good will for this Jubilee number of the BULLETIN. I do so with the greatest pleasure.

I well remember its opening by Her Majesty Queen Victoria. I had just returned from India at the end of my subaltern service. In those days I had little notion of its purpose. Thirty-three years later I had the good fortune to become its Director. I soon found out the practical and valuable work it was doing, not only in its scientific investigations on plant, animal and mineral samples, but in its educational possibilities concerning our Dominions and Colonies.

May it ever increase in its mission of giving practical aid to each and every part of our glorious Empire.

*From LIEUT.-COLONEL SIR DAVID PRAIN, C.M.G., C.I.E., M.A.,
M.B., LL.D., F.R.S.E., F.L.S., F.R.S., F.Z.S., Chairman,
Advisory Council on Plant and Animal Products, Imperial
Institute, 1926-35.*

The Well Farm,

Whyteleafe,

Surrey.

My Dear Lindsay,

I am glad to learn that it has been arranged to devote a special number of the BULLETIN of the Imperial Institute to the celebration of the close of the fifth decade of the existence of the Institute.

As one who had the honour of serving, at the invitation of the Scientific and Industrial Research Department, for one of these decades, as a member of the Institute's Advisory Council, Plant and Animal Products, I would like to offer you my warm congratulations on this occasion and to express my sincere wishes for the continued welfare and renown of the Institute.

I retain a very vivid and pleasant recollection of the readiness with which the various members of that Advisory Council placed their wide and varied knowledge at the service of the Institute and of the care and precision with which that wise and efficient officer of the Institute, the late Mr. H. Brown, placed on record the proceedings of our Council, and I still regret, in his death, the loss of a personal friend.

But, as a constant reader of the Institute's BULLETIN, I feel satisfied that the members of the Plant and Animal Products Council remain as helpful as ever and that the late Mr. Brown's successors follow his example, and therefore anticipate that during succeeding decades the welfare and renown of the Imperial Institute will remain unimpaired.

Yours sincerely,

(Signed) D. PRAIN.

From SIR RICHARD REDMAYNE, K.C.B., M.Sc., M.Inst.C.E., M.Inst.M.E., F.G.S., Chairman Governor, Imperial Mineral Resources Bureau, 1918-25; Chairman, Advisory Council on Mineral Resources, Imperial Institute, 1925-35; Acting Director, Imperial Institute, 1925.

32 Victoria Street,
Westminster, S.W.1.

My Dear Lindsay,

May I as one who was for some years closely connected with the work of the Imperial Institute, and who still has its interest very much at heart, send you my hearty greetings on the occasion of the fiftieth anniversary of the opening ceremony, and with them my best wishes for its continued success in its manifold activities.

Having been for seven years the Chairman Governor of the Imperial Mineral Resources Bureau, which in the year 1925 amalgamated with the Imperial Institute, and for nine years Chairman of the Advisory Council on Mineral Resources, with six months in 1925 as Acting Director of the Institute, I realise perhaps better than most people what the Institute stands for and is. Indeed, the measure of its usefulness to the Empire, and through the agency of the Empire to mankind is, in my opinion, only determined by the extent of financial support which is accorded to it.

Wishing you every success,

I am,

Sincerely yours,

(Signed) R. A. S. REDMAYNE.

THE STORY OF THE IMPERIAL INSTITUTE

By SIR HARRY LINDSAY, K.C.I.E., C.B.E.,
Director of the Institute since October 1934

IT was royal weather on the morning of May 10, 1893, when Queen Victoria drove in state from Buckingham Palace to open the Imperial Institute. A most distinguished assembly was gathered to welcome Her Majesty and to witness the ceremony, Cabinet Ministers, ambassadors, representatives of Canada (then the only Dominion) and of the Colonies ; of India and the Indian States ; of learned societies and industrial and commercial organisations ; and last, but not least, members of the Governing Body and Fellows of the Institute. H.R.H. the Prince of Wales (later King Edward VII), the originator of this memorial to the Queen's golden jubilee, and President of the Institute, was accompanied by the Duke of York and Princess Mary of Teck, whose betrothal had only recently been announced ; indeed this was the first occasion on which "our beloved Princess May" had appeared in public with her fiancé, the future King George V. We are honoured indeed that Queen Mary has sent us a message of goodwill in celebration of an event which Her Majesty still vividly remembers, a message reprinted as our Foreword to this special issue of the BULLETIN. This message, and the frontispiece, are tokens of Queen Mary's good wishes to this Institute and an enduring inspiration to us in our work ; for Her Majesty has always taken a very special interest in the Imperial Institute and has shown this interest in practical ways, not only by personal visits, but also by gifts of valuable and beautiful exhibits illustrating the arts and crafts of many countries of the Empire.

Funds for the erection and endowment of the building had been contributed by many millions of Queen Victoria's subjects throughout the Empire, in sums ranging from one penny to ten thousand pounds. The total amounted to £429,000, of which £140,000 was set aside as a permanent endowment and the balance utilised on the structure and its equipment. Nearly one quarter of this total (a sum exceeding £100,000) had been contributed by the people, and particularly the Princes of India. The foundation stone, which had been laid by Queen Victoria on July 4, 1887, consisted of a block of Cape Colony granite from Paarl, standing on a pedestal of Indian bricks, "which in their turn cover a specially-prepared cavity containing current coins of the realm and a number of documents of a public character," to quote a contemporary account.

The site leased to the Imperial Institute by the Royal Commissioners of the Exhibition of 1851 covered an area of nearly nine acres between the Prince Consort and Imperial Institute Roads. The architect was Mr. Thomas E. Collcutt, and the firm of contractors employed for the construction of the buildings was Messrs. Mowlem & Co. In its original form the Imperial Institute comprised

not only the main (existing) building and the Galleries, but also pleasure grounds and provision for social amenities for the Fellows and their guests. An early plan of the grounds shows that the north-western and north-eastern quadrangles were laid out as gardens, with fountains playing, and that the former quadrangle was ringed round with verandahs for the use of Fellows and their guests.

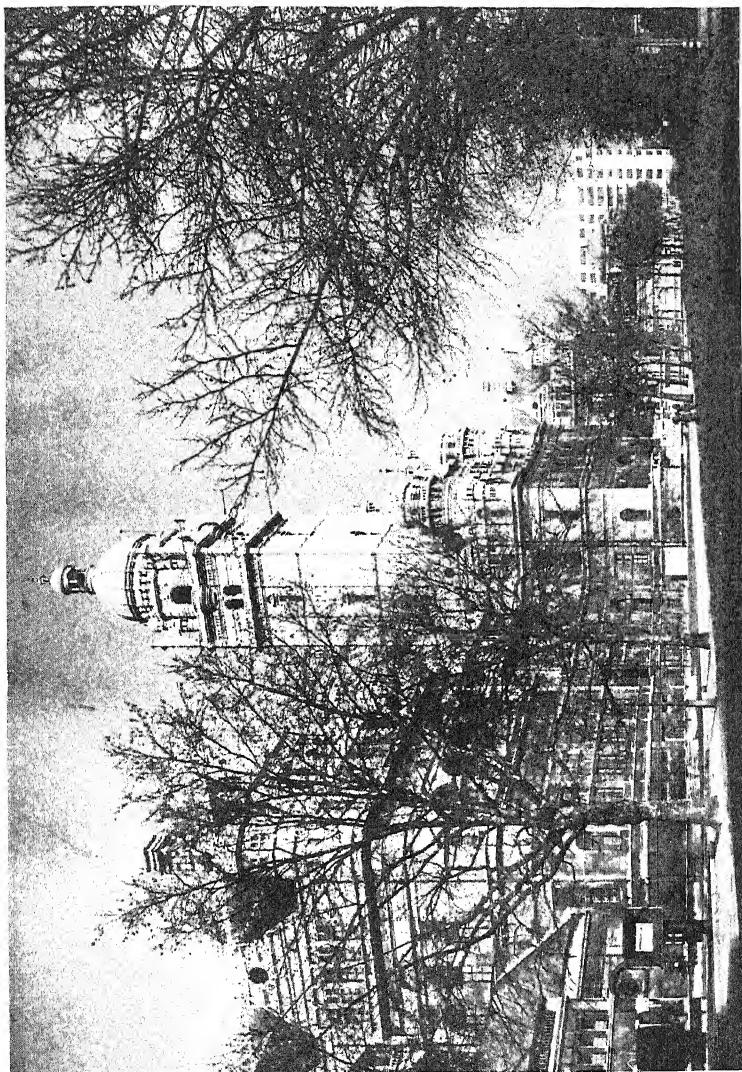
A prominent feature of the building is the great central tower, nearly 300 ft. high, with two flanking towers (illustration opposite). The central tower contains a peal of ten bells weighing over 8 tons, suspended in a bell-chamber 200 ft. above ground level. The peal was a gift by Mrs. E. M. Millar, of Melbourne, a condition of the gift being that the bells should be rung on the birthday and accession-day of the Sovereign and on the birthdays of the Prince and Princess of Wales.

The Royal Charter of Incorporation was granted by Queen Victoria on May 12, 1888. It constituted a Corporation and a Governing Body, of which H.R.H. the Prince of Wales was appointed the President. The first Governing Body included many well-known names, amongst them the Duke of Fife, Lord Salisbury, Lord Rosebery, Lord Rothschild, Lord Herschell, Mr. John Morley; also representatives of the Dominion and Provinces of Canada—the representative of the Dominion being Sir Charles Tupper (whose son, the Hon. William Tupper, K.C., formerly Lieutenant-Governor of Manitoba, has sent a message of goodwill to the Institute, printed in this volume with other messages); representatives of the Australian Colonies, Tasmania and New Zealand; of Cape Colony and Natal, Newfoundland and the Crown Colonies. India was well represented by fifteen Governors, nine for the Presidencies and Provinces, four for the Chambers of Commerce and two for Indian Institutions. Commercial and industrial organisations of the United Kingdom, learned and scientific societies were also represented on the Governing Body.

The Royal Charter defined the purposes of the Corporation as follows:

- (1) The formation and exhibition of collections representing the important raw materials and manufactured products of Our Empire and of other countries, so maintained as to illustrate the development of agricultural, commercial, and industrial progress in Our Empire, and the comparative advances made in other countries.
- (2) The establishment or promotion of commercial museums, sample-rooms and intelligence offices, in London and other parts of the Empire.
- (3) The collection and dissemination of such information relating to trades and industries, to emigration, and to the other purposes of this Our Charter as may be of use to the Subjects of Our Empire.

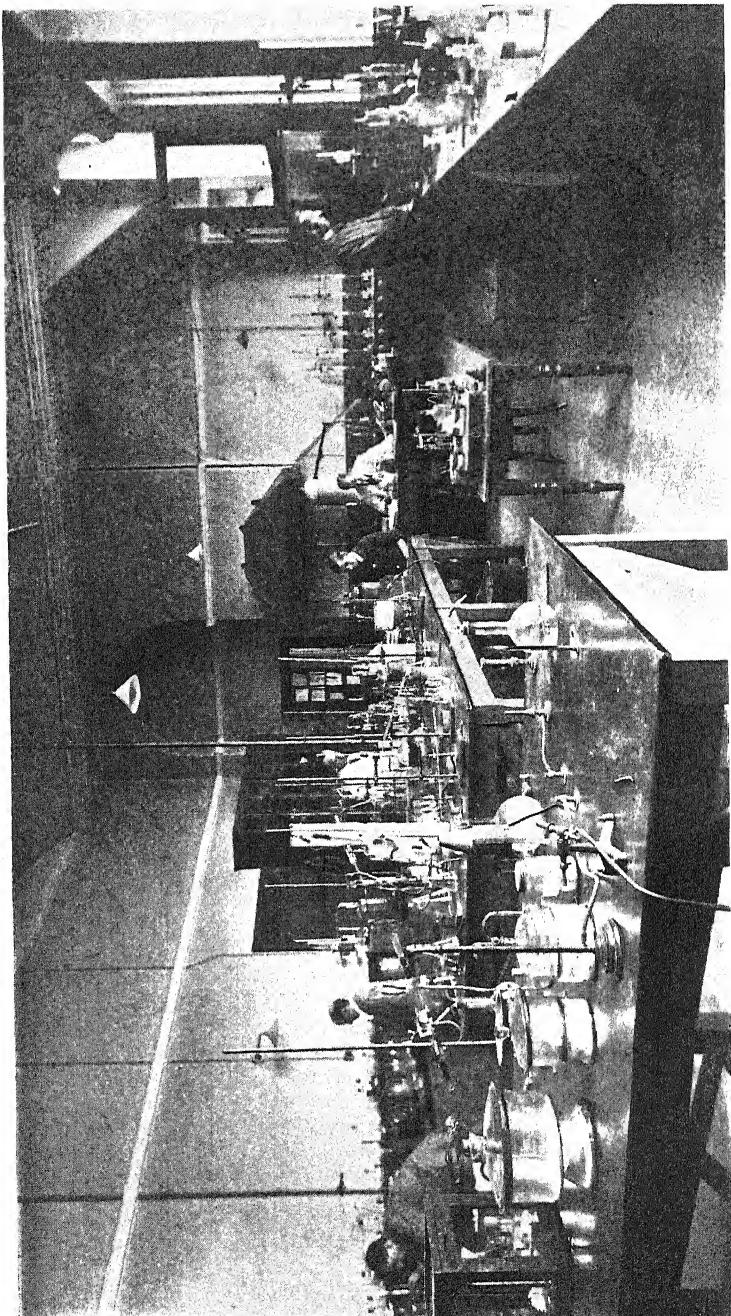
PLATE I.



IMPERIAL INSTITUTE BUILDING.

[By courtesy of the British Council.

PLATE II.



ONE OF THE LABORATORIES OF THE IMPERIAL INSTITUTE.

- (4) The advancement of trades and handicrafts by exhibitions of special branches of industry and commerce, and of the work of artizans and of apprentices.
- (5) The promotion of technical and commercial education and of the industrial arts and sciences.
- (6) The furtherance of systematic colonisation.
- (7) The promotion of conferences and leetures in connection with the general work of the Institute, and the facilitating of commercial and friendly intercourse among the inhabitants of the different parts of the British Empire.
- (8) The doing anything incidental or conducive to carrying into effect all or any of the foregoing purposes.

There are three points of special interest. Firstly, emphasis is laid on the permanent exhibition of economic products of the Empire in the Galleries of the Institute. Secondly, this exhibition is closely linked with the responsibilities of the Institute as a Technical Intelligence Bureau. Thirdly, the promotion of industrial arts and sciences is linked with commercial and friendly intercourse between all parts of the Empire ; in other words that all Empire citizens should get to know each other better and benefit by mutual progress in art and science. It is interesting to trace this triple motif in the subsequent history of the Institute.

It is unnecessary to describe in detail the financial crisis through which the Institute passed during its early years, or the reasons which necessitated :—In 1899, the discharge by Government of a mortgage on the building, and the payment of a floating debt ; the transfer of the building and site to Government ; and the transfer of half the building to the University of London—In 1902, the vesting in the Board of Trade of the building and property of the Imperial Institute (subject to the rights of the University of London) and the control of the endowment fund and current finances—In 1907 the transfer of control to the Secretary of State for the Colonies, a transfer confirmed by Act of Parliament in 1916. The first Director had been Sir Frederick Augustus Abel, Bart., G.C.V.O., K.C.B., D.C.L., D.Sc., F.R.S., who died in 1902 and was succeeded in 1903 by Professor Wyndham Dunstan, M.A., LL.D., F.R.S., now Sir Wyndham Dunstan, K.C.M.G.

The purposes for which the Institute had been founded were not changed by this legislation. Nevertheless important developments had occurred. The social amenities were much curtailed as a result of the reduction of space effected when the University of London entered into occupation of half of the main building ; the annual Fellowships were not renewed ; and the Institute settled down whole-time to its more serious tasks as a centre of technical information devoted to the development of the economic resources of the Empire. In particular the laboratories, the construction of which was foreshadowed in the terms of the Royal Charter, had been equipped and gradually expanded until they came to fulfil an

important rôle in the Institute's programme of work. Indeed the Institute is perhaps unique in the history of Technical Intelligence Bureaux in that it not merely records information collected from world-wide sources, but also prepares in its own laboratories much of the information required—a service very much more individualistic and therefore more highly prized by the inquirer, whether official or unofficial, than if it were confined to the recording and dissemination of published information. Moreover, the value of the service is greatly increased when (as in the case of the Imperial Institute) samples and specimens sent for analysis and report are carefully classified and kept for future reference as required.

An account of the activities of the Institute, recorded in 1916, describes the Public Exhibition Galleries, with the Central Stand for Publications and Enquiry Office attached (the Galleries were visited in 1915 by nearly 187,000 persons)—the Scientific and Technical Department with its Laboratories and Intelligence Offices and its Reference Sample Room ; its Technical Reports and Scientific Papers on a great variety of products, animal, vegetable and mineral ; and its Mineral Surveys—the Technical Information Bureau, supplying technical information to inquirers and issuing special circulars and pamphlets on such subjects as " New Markets for Indian and Colonial Copra," " Wattle or Mimosa Bark for Tanning," " The Production and Utilisation of Molybdenite," " New Markets for Indian and Colonial Groundnuts and their Products," " Plumbago (or Graphite) from Ceylon " and " Palm Kernel Cake and Meal"—the Library, Reading Rooms and Map Room—the Tropical African Services Course—the Colonial Conference Rooms—the Cowasjee Jehanghir Hall—the BULLETIN OF THE IMPERIAL INSTITUTE—and the Imperial Institute Handbooks on Tropical Resources.

In the debate in the House of Lords, after Lord Islington, then Under-Secretary of State for India, had moved the second reading of the Imperial Institute (Management) Bill of 1916, Lord Milner referred to the Institute in the following terms :—

" We have been in the past extraordinarily indifferent to the enormous resources of our Colonial Empire, and especially of the Crown Colonies, and we have been equally indifferent to the importance of science in every branch of our public life and in the development of the resources of our Empire.

" It has been a matter of extraordinary difficulty in my experience—and I dare say the noble Lord will agree that it has been so in his, for we have occupied somewhat similar positions in the past—to get any sympathy or appreciation in this country for the possibilities of what the late Mr. Chamberlain once called ' our vast undeveloped estate.' A new spirit, no doubt, came into Imperial administration with his advent to the Colonial Office, and I am glad to be able to say that, certainly as far as the Crown Colonies

are concerned, the progressive spirit which he introduced has been maintained by his successors. Altogether there has been more progress in the last ten or fifteen years in what I may call the appreciative administration and the sound economic development of the dependent Empire, especially of the great tropical Crown Colonies, than in all our past history, certainly for fifty or a hundred years past.

“We are a very small assembly here to-day, and in the midst of the tremendous question of Imperial policy with which we are all confronted a matter of this kind may appear of comparative insignificance. Certainly it does not attract a large audience. But I feel honestly convinced that if the Imperial Institute is really to be a central home of science and research for the development of the products of the Empire, and if those who are responsible for its administration are to realise that in it they have an instrument which may be of fundamental importance, not only economically but politically, in welding the Empire together, I say the matter which we are discussing to-day may come to be looked back upon in the future as one of the most important subjects brought before this House. There can be no question, of course, that this measure will pass. I may possibly have something to say on minor points in Committee. But the main point is that we should all realise how big a subject it is with which we are dealing. Above all I would venture to express the fervent hope that the history of the Imperial Institute may not be in the future what it has been in the past—namely, a great splash followed by years of negligence—but that this Government and successive Governments may continue to recognise its immense importance and give it that liberality in money without which it cannot accomplish its great objects so eloquently described by the noble Lord.”

During and immediately after the war of 1914-18 important changes occurred. During the war the Galleries were requisitioned by Government for office purposes and the collections of economic specimens and other exhibits were removed for storage. In 1919 there was formed by Royal Charter an Imperial Mineral Resources Bureau, to carry out duties in relation to minerals intelligence closely analogous to those which had been entrusted to the Imperial Institute in the whole domain of raw materials, animal and vegetable as well as mineral. Indeed, there is evidence that for some years there was overlapping between the two bodies so far as minerals were concerned.

The Imperial Institute itself was in financial straits, and it was not long before the Imperial Mineral Resources Bureau experienced the same difficulty—lack of adequate financial support on the part of the Empire Governments whose interests it served. An Imperial Institute Committee of Enquiry was set up in February 1923 by the Secretary of State for the Colonies under the chairmanship of

the Right Hon. Lord Harlech (then the Hon. W. G. A. Ormsby-Gore, M.P., Parliamentary Under-Secretary of State for the Colonies) to inquire into the functions of the Institute ; to consider which were essential and how these should be continued ; and to suggest any improvements which might be financially possible. The membership of the Committee included representatives of the Dominions, India and the Colonies as well as of the Board of Trade and the Treasury. The report of this Committee was taken into consideration by the Imperial Economic Conference of 1923. And finally the future of the Imperial Institute was determined by the Imperial Institute Act of 1925.

This Act appointed the Secretary of the Department of Overseas Trade to be the Minister responsible for the control of the Imperial Institute, its buildings, its finance and its activities. The Minister was also appointed President of the Board of Governors, who, under him, are responsible for the management of the Institute. The rights of the University of London over half of the main building were maintained. The Imperial Mineral Resources Bureau was amalgamated with the Imperial Institute. It was provided that the Institute should be adequately financed by the Home and Overseas Empire Governments. And, finally, the Act redefined the purposes of the Institute as follows :

1. To promote the commercial industrial and educational interests of the British Empire.
2. To collect and disseminate :
 - (a) information relating to possible uses of and markets for new raw materials or semi-manufactured products ;
 - (b) information relating to new uses of and markets for already known raw materials or semi-manufactured products ;
 - (c) information relating to sources production supplies cost consumption and requirements of raw materials and semi-manufactured products and legislation relating thereto ;
 - (d) information relating to the best means of increasing supplies or of creating new sources of supplies of such materials and products within the Empire ;
 - (e) information relating to the best means of treating such materials and products and of preparing them for marketing ;
 - (f) technical and scientific information bearing upon the industries of the British Empire.
3. To advise on the development of the resources of the Empire in raw materials in order that such resources may be made available for the purposes of industry and commerce and of Imperial defence.
4. To conduct in the laboratories of the Institute preliminary investigations of raw materials and when it may be deemed advisable to arrange for more detailed investigation by appropriate scientific or technical institutions.
5. To collect samples of raw materials having a definite value in industry and commerce.

6. To co-operate with other agencies within the Empire formed for similar purposes.

7. To maintain for public information and instruction in the exhibition galleries of the Imperial Institute exhibitions illustrative of the resources and development of the Empire and of its scenery, life and progress and where practicable to organise from time to time temporary exhibitions of a similar nature elsewhere.

8. To do anything incidental to or conducive to carrying into effect all or any of the foregoing purposes.

A comparison of these "Purposes" with those laid down in the Charter makes it at once obvious that, whilst the general objects are the same, the Act of 1925 deliberately varied the emphasis on the different functions which the Institute was to carry out; and it defined them in greater detail:—

Firstly, chief emphasis is now laid on the responsibilities of the Institute as a Technical Intelligence Bureau, and the Laboratories (a view of one of the Laboratories faces p. 13) are now included in the "Purposes" as a necessary adjunct to the Bureau; the Laboratories had been in existence for many years before, but they had been continuously expanded and developed and their importance was now definitely and finally recognised. Imperial defence is now included as one of the objects which the examination of Empire resources at the Institute is intended to serve.

Secondly, the collection of samples of raw materials of economic value is retained as a "Purpose"; such collections are, however, no longer intended for public display in the Galleries but rather for internal use in the Institute, for reference purposes and as an adjunct to the primary task of collecting and disseminating Technical Intelligence. Thirdly, the Galleries are to be devoted to the maintenance, "for public information and instruction," of exhibitions "illustrative of the resources and development of the Empire and of its scenery, life and progress."

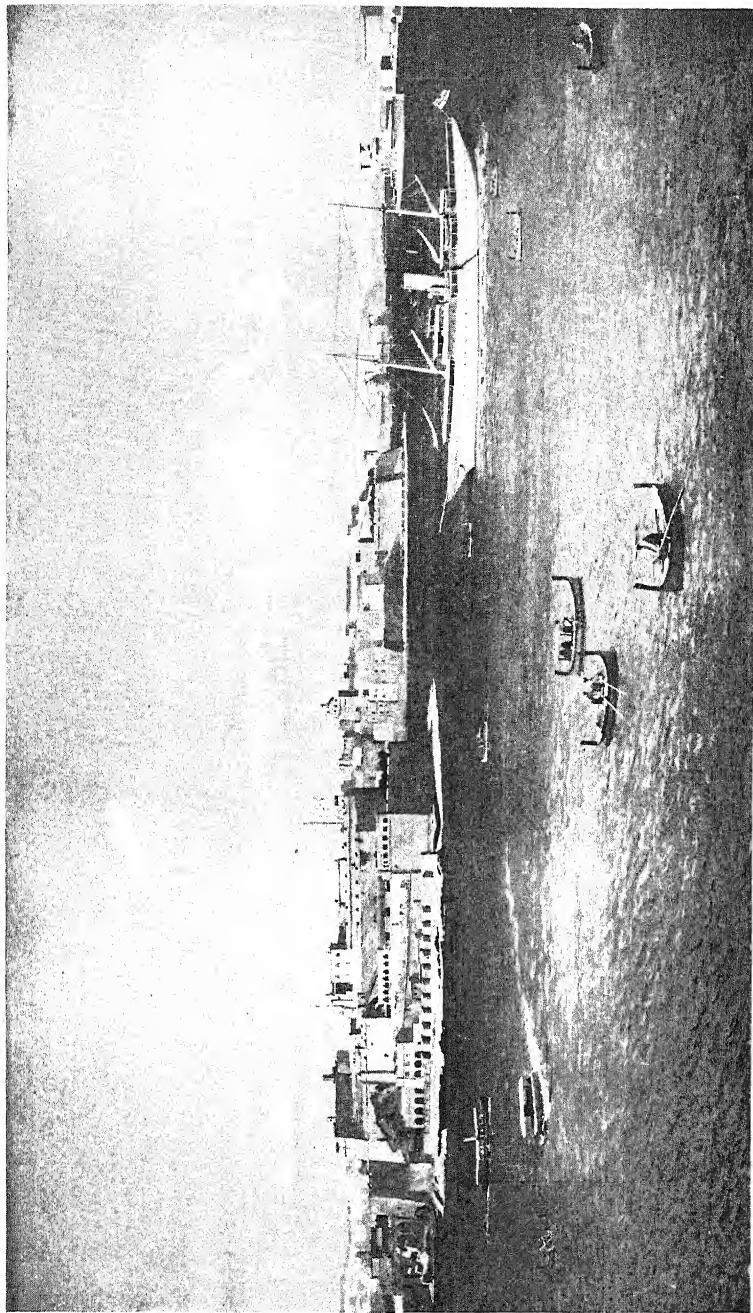
The machinery by which these duties are carried out at the Imperial Institute, as well as some of the results secured, are described in the articles which follow and need not be explained here. Special mention should, however, be made of the two Advisory Councils (one on Plant and Animal Products and the other on Mineral Resources) and of the twenty-two Advisory Committees, each dealing with one or other of the staple raw materials of industry, which were constituted after the Act of 1925 became law. From its earliest days the Institute had relied on the advice and assistance of Technical Committees and special provision was made in the Act for the creation of the two Councils and of the Committees which they control. The twenty-two Advisory Committees have since been reduced to fifteen and have been renamed Consultative Committees.

The first Chairmen of the two Councils on Plant and Animal Products and Mineral Resources were, respectively, Lieut.-Colonel

Sir David Prain, C.M.G., C.I.E., M.A., M.B., LL.D., F.R.S.E., F.L.S., F.R.S., and Sir Richard Redmayne, K.C.B., M.Sc., M.Inst.C.E., M.I.M.E., M.Inst.M.M., F.G.S. In 1935 Sir David Prain was succeeded by Mr. F. A. Stockdale, C.M.G., C.B.E. (now Sir Frank Stockdale, K.C.M.G.), and he in 1940 by Dr. H. A. Tempany, C.M.G., C.B.E., F.I.C. In 1935 Sir William Larke, K.B.E., succeeded Sir Richard Redmayne as Chairman of the Advisory Council on Mineral Resources. The grateful thanks of the Director and his scientific staff are due to all those experts in the fields of science, commerce and administration, who as Chairmen or members of the Councils and Committees give ungrudgingly of their time and experience to help in the solution of the particular problems on which the Institute consults them, as occasions for consultation arise in the course of the work of the Institute.

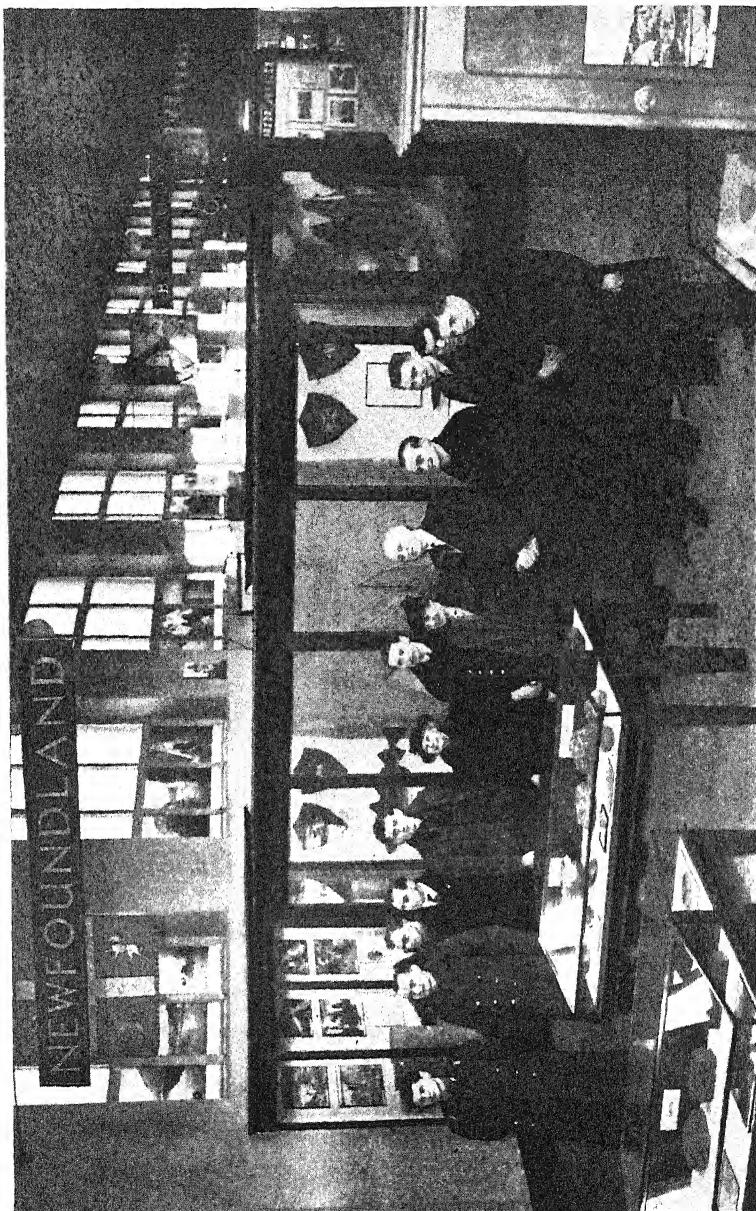
On the educational side one development calls for notice. The term "visual instruction" had not, perhaps, attained common parlance when the Act of 1925 was drafted. It is now used, and understood, by all. The Board of Governors of the Institute have encouraged the development of new methods by which the story of the Empire can be told to the general public of this country. Thus a large number of illuminated dioramas—modelled colour-scenes of life in the countries of the Overseas Empire—have been introduced into the various Courts of the Exhibition Galleries (illustrations face pp. 18 and 69); these are supported by relief maps, photographs arranged in travelogue form, window transparencies, etc. The exhibits in the showcases have been arranged in sequences which tell the story of each staple Empire industry from the raw material to the finished product. Statuettes of famous Empire-builders have been placed, each in its appropriate Court with a label describing the life of the hero represented; an illustration of the statuette of Cabot faces p. 68. Coloured banners and badges of the various Empire States adorn the walls of the Courts. So long ago as 1927 a Cinema capable of holding audiences of 375 persons was built as an adjunct to the Galleries, from funds provided by the Empire Marketing Board, which had also accumulated a magnificent collection of Empire films with the help of the Home and Overseas Governments. This Empire Film Library was located at the Institute and was used both for the display of films (every morning and afternoon) in the Cinema and also for their circulation to schools and approved societies throughout the United Kingdom. The Cinema was also used as a hall in which weekly lectures on the Overseas Empire were given to schools visiting the Institute for this purpose. The lecturers were all carefully selected for their first-hand knowledge of the Empire countries on which they lectured. A Library of lantern-slides illustrating the life, scenery and industries of the Empire has been gradually built up by the Institute with the assistance of the Victoria League, the Royal Empire Society, the Colonial Empire Marketing Board and

PLATE III.



DIORAMA OF THE GRAND HARBOUR, MALTA, G.C.

PLATE IV.



GROUP OF DOMINION AND COLONIAL VISITORS IN THE NEWFOUNDLAND COURT.

other organisations, and is now a very fine library of over 22,000 slides ; these are not only used by the lecturers but are also lent freely, like the films, for the use of schools and approved societies. Picture postcards illustrating Empire industries, pamphlets, school specimens and other visual aids to a knowledge of the Overseas Empire, are also maintained at the Institute for school use. With these educational activities the name of Lieutenant-General Sir William Furse, K.C.B., K.C.M.G., D.S.O., who was Director of the Institute 1926-34, is particularly associated.

The rest of the story is easily told. On the outbreak of war many of the staff joined up, some were called up and others were summoned for special work in one or other of the emergency Ministries. Normal peace-time inquiries came to an end, and the Institute settled down to make its own characteristic contributions to the war effort.

As regards the Institute's scientific and technical work under present conditions, it is sufficient to say that both the Plant and Animal Products and the Mineral Resources Departments are engaged as fully as their depleted staffs will allow on laboratory and intelligence war-work for which they are admirably qualified both by training and by experience. Three developments in particular are worthy of notice. The Institute has always worked in close touch with the Colonial Office, by whose courtesy technical and administrative officers of the Colonial Governments are encouraged to visit the Galleries, Intelligence Offices and Laboratories to exchange information and advice with the Institute staff. First Sir Frank Stockdale, K.C.M.G., C.B.E., and then Dr. H. A. Tempney, C.M.G., C.B.E. (his successor as Agricultural Adviser to the Secretary of State for the Colonies), have been Chairmen of the Institute's Advisory Council on Plant and Animal Products, and the latter still holds this office. Contacts with the Colonial Office have been still further strengthened by the recent appointment of Dr. J. L. Simonsen, F.R.S., to the post of Director of Colonial Products Research and by the accommodation of himself and his office staff at the Institute, where he is in close touch with Dr. S. E. Chandler, O.B.E., Principal of the Plant and Animal Products Department of the Institute.

Secondly Sir William Larke, K.B.E., Chairman of the Institute's Advisory Council on Minerals, is also Chairman of several Technical Committees of the Ministry of Supply ; thus, through him, and particularly in his capacity as Controller of Non-Ferrous Minerals Development, the Institute is assured that its technical intelligence and laboratory facilities are known and readily accessible to the Departments of the Ministry which deal with minerals. Thirdly, an officer of the Mineral Resources Department of the Institute has been seconded to the Ministry of Economic Warfare where he acts as liaison officer, ensuring close co-operation between the Ministry and the Institute.

The close relations of the Institute with the Department of Overseas Trade, which began with the passing of the Imperial Institute Act of 1925, have continued ever since. Mr. Harcourt Johnstone, M.P., the present Secretary of the Department, is the Minister responsible to Parliament for the affairs of the Institute and is also President of the Board of Governors. His introductory message of goodwill to the Institute on the celebration of the fiftieth anniversary of its opening is printed on p. 1 of this volume, which also includes messages from Dominion, Indian, and Colonial well-wishers of the Institute, former Directors and former Chairmen of Council.

With regard to finance it is satisfactory to note that with few exceptions every Dominion, India and Burma, all Crown Colonies and Protectorates, as well as the territories mandated to the United Kingdom, were contributing towards the maintenance of the Institute until the outbreak of the present war; and that even now very few abstentions have occurred—a most encouraging tribute to the value attached by all Governments of the Empire to the services which the Institute renders.

The Galleries and Cinema were both closed on the outbreak of war. It was not long, however, before the Institute was able to establish, with the Ministry of Information, the Board of Education and the British Council, relations no less close and fruitful in the educational field than those which it established with the Ministries of Economic Warfare, Production and Supply in the field of science and technology. The Ministry of Information employs the Institute as its agent for the circulation of its films throughout the United Kingdom; and for this purpose a Central Film Library has been established from which the Ministry's own films, as well as those of the General Post Office and of the Empire Film Library, reach numerous audiences in all parts of this country. During the past year the circulation of all films of the Central Film Library has attained the very satisfactory daily average of 330 despatches and returns. Generous grants from the Imperial Relations Trust have enabled the Institute to maintain and increase its stock of Empire films, to supplement those received by courtesy of the Canadian and other Empire Governments.

In co-operation with the British Council, special arrangements have been made whereby the Galleries and Cinema are available for the use of parties of foreign visitors to the Institute. These visits, and those paid by the United Kingdom, Dominion, Indian and Colonial members of His Majesty's Forces (in co-operation particularly with India House for parties of the Royal Indian Army Service Corps and with the Forum Club for parties of Dominion and Colonial troops) have been so much appreciated that in December 1942 it was decided to throw open the Galleries and Cinema to the general public. The response has been most satisfactory. Empire films are shown in the Cinema every afternoon.

Voluntary helpers of the Women's Voluntary Services and of the Forum Club assist the Institute staff in patrolling the Galleries and explaining the exhibits to visitors; the grateful thanks of the Institute are due to these ladies for the efficient help which they give and without which it would have been impossible to reopen (illustrations of a school party conducted round the Galleries by the Assistant Curator and of a party of Dominion visitors with voluntary helpers and with the Director face pp. 19 and 62).

In addition to the Galleries and Cinema, other services rendered by the Imperial Institute to the general public, and particularly to schools, as aids to Visual Instruction in the Empire, have been developed and extended to meet varying demands under pressure of war conditions. The Empire Lantern Slide Library, like the Empire Film Library, is in great request; also a series of leaflets and posters (small-scale reproduction faces p. 63) which trace the stories of the principal economic products of the Colonial Empire from the raw commodities to the finished goods. All these materials are greatly valued by school authorities interested in telling the story of the growth and activities of the Empire to their scholars. They are also, like the films, freely used by the panel of Empire Lecturers organised by the Institute to lecture on Empire subjects to schools throughout the United Kingdom.

This Empire Lectures Scheme calls for a brief explanation. Before the war it had been customary to invite lecturers, each with special knowledge of some country or countries of the Overseas Empire, to lecture in the Cinema to school-class audiences. With the closing of the Cinema on the outbreak of war these lectures could no longer be given. It was decided instead to enrol a panel of Empire lecturers and to send them to any schools which might desire their services. With the assistance of the High Commissioners, the Colonial Office, the Royal Empire Society, the Victoria League, the Overseas League and other bodies a panel of over one hundred lecturers was organised. The fees and expenses of the lecturers have been met by grants generously made for the purpose by the Leverhulme Trustees. Last season a total of 768 lectures on the Empire was given to audiences aggregating over 126,000 school children in widely-scattered areas of England and Wales. This season the demand for these lectures has greatly increased and during the first half of the season the number of lectures given was over 650. It is hoped by this means to arouse in the rising generation a keen and widespread interest in the activities of the Empire and in the ideals for which it stands.

This brief story would not be complete without some mention of the staff on whom the Director relies and whose keenness and efficiency have been directly responsible for the results achieved. Dr. S. E. Chandler, O.B.E., A.R.C.S., F.L.S., is Principal of the Plant and Animal Products Department of the Institute, assisted by Dr. J. R. Furlong, A.I.C., and Mr. H. J. Jeffery, A.R.C.S., F.L.S.,

Vice-Principals in charge of the Laboratories and Intelligence Section of the Department, with a peace-time strength of seven Senior Assistants, five Assistants and two Technical Indexers. Mr. S. J. Johnstone, O.B.E., B.Sc., F.I.C., is Principal of the Mineral Resources Department; Messrs. W. O. R. Wynn, F.I.C., and G. E. Howling, B.Sc., are the two Vice-Principals in charge of Laboratories and Intelligence respectively in the same Department; and the peace-time strength is two Senior Assistants, eleven Assistants, one Technical Assistant and three Technical Indexers. The General Secretary, Mr. J. A. Nelson, B.Sc., is on special duty with the Ministry of Supply, and his duties have been taken over temporarily by the Accountant and Establishment Officer, Mr. E. J. Palmer (seconded to the Institute from the Department of Overseas Trade). In the Secretariat are included the Librarian and Registrar and their Assistants, the Statistician, the Lantern Slides Librarian, and the Assistant Secretary who is also Assistant Accountant; these officers are assisted by a clerical, shorthand, typing and telephone staff. Mr. H. Spooner is Curator of the Exhibition Galleries, with a staff comprising an Assistant Curator, two Exhibition Officers, two Guide Lecturers and three Galleries Attendants; attached to the Institute is a Studio in which work the artists engaged on the construction of dioramas, statuettes, pictures and models for the Galleries. The work of the Central Film Library is supervised by Mr. W. Farr, B.A., seconded from the Ministry of Information, and an Assistant Secretary, with a clerical and typing staff, cinema operators and film repairers; all are maintained by the Ministry of Information. The Director acts also as Trade Commissioner for Burma, assisted in this capacity by four Burmese Officers, one Trade Intelligence and Publicity Officer, one Exhibition Officer and two Assistant Trade Intelligence and Publicity Officers, maintained by the Burma Government. The staff of the London Advisory Committee for Rubber Research (Ceylon and Malaya) consists of one superintendent, Mr. G. Martin, B.Sc., F.I.R.I., and four Assistants, with three Inspectors. Ceylon rubber producers are still paying their share of this research programme; the Imperial Institute has accepted responsibility for the share hitherto borne by the rubber producers of Malaya; the direct contributions of this Rubber Research organisation towards the war effort are maintained by the Ministry of Supply. With the Labour Staff, Galleries Patrol, Carpenters, Electrician and Printers, the total number of the staff normally employed at the Institute in peace-time exceeds 140, of whom 42 are either on active service or seconded to Ministries or Departments of the Government.

Relations between the Imperial Institute and the Learned and Empire Societies and Associations have always been close. The School of Oriental Studies, during its earliest days, was located at the Institute; also the Tropical Diseases Bureau, the British

Section of the International Association for Tropical Agriculture, the Empire Forestry Association, more recently the Research Department of the Indian Jute Mills Association, and, for a short time, the Colonial Forest Resources Development Department. The Royal Colonial Institute (afterwards renamed the Royal Empire Society), under its President, the Prince of Wales, later King Edward VII, had considered the question of union with the Imperial Institute, but the proposal fell through ; for many years before the outbreak of the present war the Society held its annual reception at the Institute. Since its earliest days Queen Mary's Needlework Guild has dispensed its annual bounties from this building, where also the Northbrook Society was located, and the Royal African Society and the Overseas Nursing Association are now accommodated. Their Majesties the King and Queen, Queen Mary, Princess Elizabeth, Princess Margaret and other members of the Royal Family have frequently visited the Institute in support of the annual War-Disabled Ex-Service Men's Exhibitions which were held in the Exhibition Pavilion and Imperial Gallery of Art from 1927 to 1938. Close relations have always existed with the Royal Commissioners for the 1851 Exhibition, who had generously provided the site for the buildings, and also with the British School at Rome ; with the Victoria League ; and now increasingly with the Empire Home and Press Divisions, and the Films Department, of the British Council.

SCIENTIFIC AND TECHNICAL DEPARTMENTS
PLANT AND ANIMAL PRODUCTS

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Department*

THE first fifty years of the history of the Imperial Institute has coincided with a remarkable development of the natural resources of the countries of the Empire. The possibilities of development were clearly envisaged by those responsible for the establishment of the Institute who appreciated the need for a comprehensive knowledge of the economic resources of the Empire, and recognised the aid and impetus that would be given to their development by the availability of organised scientific and technical information regarding the properties and value in industry and commerce of overseas raw materials, many of them likely to be new or little known. In addition, therefore, to the display of comprehensive collections of natural products from all parts of the Empire, which were to be available for inspection by the commercial community and the general public, a primary object in the planning of the Institute was "the establishment of a department to deal with the subjects of scientific research and practical or expert examination and testing which are indispensable to its operation."

Action taken on that declaration was the germ of the scientific and technical work of the Institute which during half a century has been devoted to furthering the development of the natural resources, of plant, animal and mineral origin, of the countries of the Empire, and which at the present day is carried out by two fully organised departments, *viz.*, the Plant and Animal Products Department and the Mineral Resources Department.

Lack of adequate funds prevented the immediate formation and maintenance of a research department, and a temporary scheme was put in operation whereby well-known scientific investigators and practical experts collaborated in an honorary capacity with the Imperial Institute by examining and reporting on overseas products submitted to them. Among the products first examined under

¹ Entered Imperial Institute Service in 1904.

² Entered Imperial Institute Service in 1906.

³ Entered Imperial Institute Service in 1911.

this arrangement were fibres, tanning materials and opium from India.

Meanwhile, in 1894, a number of eminent scientific men were appointed as a Committee of Advice, operating through technical Sub-Committees, to advise upon the organisation and working of the proposed research department, and with the financial help of the Royal Commission for the Exhibition of 1851 and the Goldsmiths Company "two young chemists" were engaged and commenced the examination of Indian coals and iron ores, and fibres from India and the Colonies. The Technical Sub-Director in charge of the Laboratories was Dr. Theodore Cooke, C.I.E. In 1896 Professor (now Sir) Wyndham Dunstan, F.R.S., was appointed Director of the Scientific and Technical Department of the Institute. With further financial help the scientific staff was increased, the Laboratories extended, and work was carried out within a short period for the Indian and Colonial governments.

The staff of the reorganised Department consisted of three Senior Chemists (including Mr. F. H. Carr, now a Director of British Drug Houses, Ltd.) and seven Junior Chemists, some of whom gave long service to the Institute and contributed greatly to building up all phases of its scientific work. Of these Dr. T. A. Henry, after serving for many years as Superintendent of Laboratories, left in 1920 to take up the Directorship of the Wellcome Chemical Research Laboratories, a position he still holds; Mr. Harold Brown remained at the Institute until his death in 1936, having been Principal of the Plant and Animal Products Department since its inception in 1926; whilst Dr. E. Goulding retired as Vice-Principal of that Department on reaching the age limit in 1935. Another member of Professor Dunstan's original staff, Mr. A. E. Andrews, left in 1919 to take up a position with a commercial firm. Mr. R. G. Pelly, who joined the staff a little later, also did valuable work over a long period, particularly in relation to oils and oilseeds, fibres and rubber.

By 1900 an Advisory Committee for the new Department had been appointed, and in the following year the Committee considered a memorandum prepared by the Secretary and Director of the Institute (Sir Frederick Abel) and the Director of the Scientific and Technical Department describing the organisation and operations of the Department with examples of its work and indicating methods by which the work could be expanded to the advantage of overseas countries. This memorandum formed the enclosure to the important despatch of the Colonial Secretary (Mr. Joseph Chamberlain) to Colonial Governments in 1901 which did so much to bring the work of the Institute to public notice in the Empire; and a similar purpose was served by the circulation of the memorandum in India, to the foreign Consular Service by the Foreign Office and by its publication in the Board of Trade Journal. Extensive use was made of the services thus offered, and expansion of the scientific

staff of the Department and additional laboratory equipment followed. It became possible to allot members of the staff to the investigation of natural groups of raw products, e.g. fibres, oils and oilseeds, feeding stuffs, drugs, gums and resins, rubber and gutta, minerals, coal and petroleum, etc. Unofficial scientific experts assisted in investigating special subjects and, together with a number of manufacturers, brokers and merchants who reported on the industrial and commercial value of the commodities examined in the Laboratories, formed panels of Expert Referees rendering invaluable assistance to the Department. In due course an expanded and experienced staff, provided with increased laboratory and workshop equipment, was able normally to undertake the scientific investigations required in connection with the problems which reached the Department in rapidly increasing number and scope, though collaboration with the technical and commercial referees was, as at present, fully maintained. Throughout, valuable assistance has been given by the Director and staff of the Royal Botanic Gardens, Kew, in the identification of material sent to the Institute for investigation.

By 1902 the amount of scientific and technical work carried out by the Imperial Institute since its inception justified publication of the collected results, and in that year the volume of "Technical Reports and Scientific Papers" was published, recording the results of the examination of several hundred samples, and containing, as reprints from scientific journals, professional papers by the Director and staff, and by expert referees. Between 1909 and 1914 a series of Selected Reports was published recording the results of the more important investigations of Fibres, Gums and Resins, Foodstuffs, Rubber and Gutta Percha, and Oils, Oilseeds, Fats and Waxes, received from all parts of the Empire.

Meanwhile the work of answering by correspondence or personal interview technical inquiries not involving laboratory investigation had steadily developed, a task shared by the scientific staff which had been appointed to the Public Exhibition Galleries, and originally undertaken in a limited way by a branch of the Commercial Intelligence Department of the Institute established in 1895. In order to cope with and extend the usefulness of this increasing work a Technical Information Bureau was formed in 1914 as a branch of the Scientific and Technical Department and quickly proved its value in dealing with the many problems during the war and subsequently. The importance of the work was recognised at the re-organisation of the Institute in 1926 when the establishment of Intelligence services was an essential feature of the new arrangements.

In 1908 the Colonial Office instituted a Tropical African Services Course for candidates selected for administrative appointments in East and West Africa. Courses of instruction in tropical economic products were given by members of the Institute staff until the

1914-18 war, when they were temporarily discontinued, to be renewed at its close for a few further years. The value of the Courses is even now referred to from time to time by officers who visit the Institute on leave or on retirement.

In 1910 the second International Congress of Tropical Agriculture was held at Brussels to which the Director and members of the staff presented important contributions, whilst four years later Professor Dunstan presided over the third International Congress, which was held at the Imperial Institute, with Dr. T. A. Henry and Mr. Harold Brown as joint Honorary Secretaries of the Organising Committee. The Proceedings of the latter Congress and two volumes of the papers presented were prepared for publication by members of the staff of the Institute.

At the request of the Colonial Office the Director visited Cyprus (1904) and Asia Minor (1907) to report on their agricultural and economic development; and also Ceylon (1910, 1914), India (1914) and Newfoundland (1914) at the invitation of the respective governments.

A valuable development of the organisation was the establishment in 1916 of Technical Advisory Committees, comprising leading commercial and scientific men and official representatives, concerned with groups of raw products, who advised on special subjects referred to them and suggested schemes of inquiry. As prominent among these Committees may be mentioned those dealing with Timbers, Silk Production and Minerals. There was also a Raw Materials Committee including representatives of the principal Chambers of Commerce in Great Britain and of the Federation of British Industries. In view of the successful work of these bodies the system was recommended for development in the changes made in 1926, and a panel of such Committees (now styled Consultative Committees) is a feature of the present organisation of the scientific and technical departments of the Institute.

Committees were also formed in 1916 for each of the principal Dominions and for India. The Committees did valuable work, especially that for India, which at the request of the Secretary of State, carried out an extensive inquiry into the possibilities of extending the industrial and commercial utilisation of Indian raw materials in the United Kingdom and elsewhere in the Empire. Special Committees were appointed to deal with the more important materials and the following Reports were published: Hides and Skins; Oil Seeds; Rice; Timbers and Paper Materials; Jute and Silk; Lac, Turpentine and Rosin; Cinchona Bark and Myrobalans.

In 1924 the Department assisted in organising for display at the British Empire Exhibition, Wembley, an exhibit illustrating the work done by the scientific departments in connection with Empire raw materials. Smaller exhibits were shown for several years at the annual British Industries Fair.

In 1925, in accordance with the recommendations of the

Committee of Enquiry, the work on mineral resources was allotted to a separate department, the Mineral Resources Department, while all raw materials of plant and animal origin were to be dealt with by a Plant and Animal Products Department. In both cases emphasis was laid upon the development of the Intelligence services of the departments and the extension of the system of advisory technical committees.

The organisation then laid down obtains at the present time. The Plant and Animal Products Department, with which this article is concerned, comprises an Intelligence Section staffed by scientific officers, including economic botanists, chemists, a tropical agriculturist and an economist, under a Vice-Principal ; an Investigations Section (Laboratories), also in charge of a Vice-Principal, assisted by a staff of chemists ; a Technical Indexing Section, engaged in indexing the voluminous technical literature, British and foreign, received in the Library ; and a series of eight Consultative Committees concerned respectively with Timbers, Vegetable Fibres, Oils and Oilseeds, Essential Oils, Gums and Resins, Tanning Materials, Hides and Skins and Insecticide Materials of Vegetable Origin ; the secretaries of the Committees are members of the staff specialising in the subjects of the Committees.

Subject to the Director, the work of the Department is under the general supervision of an Advisory Council comprising the Chairmen of the Consultative Committees and official nominees, under the present Chairmanship of Dr. H. A. Tempany, C.M.G., C.B.E., Adviser on Agriculture to the Secretary of State for the Colonies.

The wide range of work conducted in the Laboratories can be seen from the selected examples given in the succeeding sections of this article. In the present state of emergency the time of the staff is devoted to investigations having a direct bearing on the war effort.

Reference to certain aspects of the Intelligence work of the Department will also be found in the subsequent paragraphs, but it is convenient here to give a broad outline of the general character of the work. The bulk of the inquiries, which emanate from both official and unofficial sources, fall into five main groups : (1) Requests for information as to the commercial position of overseas products and the opportunities for marketing supplies in the United Kingdom. Consultation with leading firms trading in the products concerned is an important feature in dealing with these inquiries. (2) Applications from prospective producers for information regarding overseas crops, forest products and animal products, including methods employed in their cultivation or collection and preparation for the market. (3) Inquiries for particulars of standard machinery required for preparing commodities for the market and for special purposes. In most of such cases estimates for suitable plant are obtained from the makers and furnished to the inquirers. (4)

Requests from firms (frequently machinery manufacturers or, may be, merchants) for information regarding products not previously handled by them. (5) Inquiries relating to Empire sources of supply of products normally obtained from foreign countries or to Empire substitutes for such products.

Inquiries under each of these categories come in year by year, but greater emphasis is laid on certain of them from time to time. For example, the introduction of Empire Preference following the Ottawa Conference of 1932 naturally led to a large number of inquiries in the fifth group mentioned above. The same is true to-day when the need is to find alternative sources for products of countries under enemy control. Again the economic depression of 1931, which caused a great fall in the prices of staple products, such as coffee, tobacco and maize in East and Central Africa, led to numerous inquiries from planters for particulars of "high value" crops, which would help to tide the producer over that difficult period. Some of the crops then recommended, such as pyrethrum, papain and certain essential oils, have since become important crops of those areas.

Since the outbreak of war in 1939 the experience of the staff of the Department has been drawn upon by the older Government Departments, such as, for example, the Colonial Office and the Board of Trade, and especially by those technical Departments still more closely concerned with the prosecution of the war, such as the Ministry of Supply and the Ministry of Economic Warfare.

Some of the many publications issued by the Institute on specific subjects are referred to later on in this BULLETIN. In addition, the Institute has from the outset issued periodical publications dealing with matters relating to the resources of the Empire and with the various activities of the Institute. In 1892 and 1893 "Year books" were published giving statistical information about the Empire, and in January 1895 appeared the first number of the *Imperial Institute Journal*. This was a monthly periodical, of folio size, containing a digest of information concerning the commerce and economic products of the Empire, the results of investigations conducted by or on behalf of the Institute, reports of lectures delivered before the Fellows and particulars of the social functions held at the Institute. In all eight annual volumes appeared.

When the Institute was taken over by the Board of Trade in 1902, and the social activities were curtailed, it was decided to issue a new quarterly publication, the *BULLETIN OF THE IMPERIAL INSTITUTE*, to be devoted more particularly to the scientific and technical work of the Institute. The first number appeared as a Supplement to *The Board of Trade Journal* for May 21st, 1903, and the BULLETIN continued to be issued in this form for two years. From 1905 to 1911 it was published by the Institute itself, and in 1912 it was issued in an enlarged form by the publishing firm of

Mr. John Murray. In that year, too, signed articles by eminent overseas officials appeared for the first time, and illustrations were introduced. In 1936 the Institute itself again took over the publication of the BULLETIN, a system that is still in force.

Apart from the special articles of recent years the BULLETIN has been the product of the scientific staff of the Institute, and thanks are due to the numerous anonymous contributors who have helped to make it one of the leading journals of its kind. From its commencement until 1920 Dr. T. A. Henry was in charge of its preparation, under the Director, whilst afterwards Dr. E. Goulding took a leading part in the work; more recently the general editorship has been in the hands of Mr. H. J. Jeffery.

FOODSTUFFS AND FODDERS

Records show that there must be few Empire materials consumed by man and livestock which have not at one time or another been examined in the Laboratories of the Institute or been the subject of advice to producers or consumers. For example, in connection with beverages, the Institute took an active part in the establishment of the tea industry in Nyasaland, the coffee industry in East Africa and the cocoa industry on the West Coast.

As regards pulses, the work done on the Rangoon bean (*Phaseolus lunatus*), from Burma, may be selected for special mention. The seeds of certain varieties of this bean are liable to be poisonous to livestock, and investigations carried out at the Institute by Prof. Dunstan and Dr. T. A. Henry showed that this was due to the presence of a glucoside, which they named phaseolunatin, which when acted upon by an enzyme present in the seed yielded prussic acid and other substances. This work followed that done by the same authors on two similar glucosides, viz., lotusin in an Egyptian plant, *Lotus arabicus*, and dhurrin in the great millet, *Sorghum vulgare*. The production of prussic acid by plants in this way was termed "cyanogenesis" by Dunstan and Henry. Later, in conjunction with Dr. S. J. M. Auld, they showed that phaseolunatin also occurs in cassava and in flax seed (linseed). Details of this work were published in the *Proceedings or Transactions of the Royal Society* between 1901 and 1906. Subsequently the Institute in conjunction with the Burma Department of Agriculture, investigated the composition of other varieties of *P. lunatus* and also of the ordinary haricot beans, *P. vulgaris*, grown experimentally. This, and other more recent work on the estimation of cyanogenetic glucosides, was undertaken by Dr. Furlong.

Of later work, mention may be made of the part played by the Institute in starting the cassava starch industry in British Honduras and in improving the quality of the cassava starch of Nigeria; of the work done on native foodstuffs, especially that carried out for Ceylon, Nyasaland and West Africa, in connection with the efforts to improve the nutrition of the natives of those

areas ; and of the assistance rendered to many parts of the Empire in developing fruit product industries, such as fruit juices and pectin.

OILSEEDS AND OILS, WAXES

The examination of Empire oils and oilseeds with a view to ascertaining their technical characters and value for industrial or food purposes has been an important subject throughout the history of the Department. Since 1926 the work has been done in conjunction with a Committee on Oils and Oilseeds, with the late Mr. E. R. Bolton as Chairman, followed by Dr. L. A. Jordan, with Mr. G. T. Bray, of the Laboratories staff, as Secretary. A large number of seeds and oils, many of them new or little known, received from many countries of the Empire, has been investigated, and reports have been published in the *BULLETIN OF THE IMPERIAL INSTITUTE*, the earlier work also appearing in Part V of the Selected Reports (1914). The Technical Reports and Scientific Papers include a report on the examination of a very large series of Indian edible oils made in 1898 by Crossley and Le Sueur on behalf of the Institute.

The work at the Institute has included a number of important special investigations. Among these was a systematic inquiry into the several varieties of oil palm known to exist in the different West African Colonies and into the improvement of the primitive methods used by the natives to extract the palm oil. A large number of samples of palm fruits, nuts and kernels and oil was sent to the Institute for examination, largely with the object of ascertaining whether any one or more of the varieties of palm concerned could be recommended for planting in preference to others. The investigation directed much attention to the West African industry and to measures for its improvement. In 1914 the Institute drew the attention of the oil crushing trade to the availability of the palm kernels of West Africa which had been hitherto shipped almost entirely to Germany, and also to the value of the cake as a feeding stuff for livestock. As a result the imports of the kernels into the United Kingdom, which were not separately distinguished in the Trade Returns in 1913, rose to 300,000 tons by the end of the war. An Institute monograph on "Oil Seeds and Feeding Cakes," issued in 1915, dealt with palm kernels as well as other Empire oilseeds affected by the war, such as copra, ground nuts, sesame and mowra.

Another early investigation of importance related to the possibility of utilising the large quantities of seed from the Hevea (Para rubber) plantations established in the East. Examination of samples of the seed, oil and seed cake received at the Institute between 1902-1911 showed that the oil was a drying oil useful for paint and varnish manufacture though somewhat inferior to linseed oil in drying power.

Tung oil, derived from the seeds of *Aleurites fordii* and *A. montana*, is a Chinese product, highly valued in the paint and varnish industries. Samples from Hong Kong were examined as early as 1906. At the suggestion of the late Mr. E. H. Wilson, the botanical explorer, formerly a member of the staff of the Institute, the Director in 1917 arranged for seed of *A. fordii* to be sent to India and selected Colonies for cultivation trials with a view to the production of the oil in British countries. The matter was later taken up by a Sub-Committee of the Oils and Oilseeds Committee, in co-operation with the Empire Marketing Board and with Kew, the latter organising more extended planting trials. Considerable success has resulted, notably in Burma and Nyasaland, and samples of seed have also been examined from many other countries. Recently, Dr. M. Ashby, of the Intelligence staff, visited and reported on the tung plantations in the southern United States.

Much attention has also been given to perilla seed (*P. ocimoides*) and po-yok of West Africa, which also yield valuable drying oils, to the shea butter of West Africa, and to the Empire production of beeswax and other waxes.

ESSENTIAL OILS AND SPICES

Although some essential oils are distilled from wild plants most are cultivated, and the Institute has not only done a considerable amount of work on determining the character and constituents of the oils and their suitability for specific purposes, but has also given advice to prospective growers on suitable crops for particular regions, on methods of cultivation and on the processes of distilling the oils. Oils from almost every part of the Empire have been examined. In particular, reference may be made to the part played by the Institute in developing the essential oil industries of the Seychelles, of East Africa and of Cyprus. A great variety of plants yielding essential oils have been grown experimentally by the Agricultural Department in the Seychelles with a view to finding those best suited to the country and the oils produced have been sent to the Institute for examination and report. Some, like cinnamon leaf oil, are now largely exported from the Colony. Of East African oils, geranium oil has perhaps been the subject of most investigation, but peppermint and lavender and various indigenous oils have also received much consideration. In Cyprus, one of the outstanding successes has been the production of origanum oil, valued for its content of carvacrol, which possesses antiseptic properties.

Encouragement has also been given to the production of camphor, menthol and thymol in the Empire. Although hitherto the first-named has been prepared from the oil of *Cinnamomum camphora*, the Institute has been able to demonstrate that there is a promising new source of the material in the oil of *Ocimum kilimandscharicum* of East Africa.

A group of oils to which the Institute has always given particular attention is known as the aromatic grass oils, including such well-known commercial oils as citronella, lemongrass and vetiver.

Spices owe their special properties to the presence of particular essential oils and may conveniently be dealt with here. Some, like caraway, are grown in temperate regions, and commercial supplies come largely from the Continent, but the Institute has encouraged their cultivation in suitable localities in the Empire, such as the Highlands of Kenya. Others are of tropical origin, and of these much work has been done on ginger, especially in improving the quality of that grown in West Africa, and on vanilla and nutmegs.

An Advisory Committee on Essential Oils and Resins was formed in 1926 under the Chairmanship of the late Mr. A. Chaston Chapman, F.R.S., with the late Mr. O. D. Roberts, of the Laboratories staff, as Secretary. In 1937 it was reconstituted as a Consultative Committee on Essential Oils only, with Dr. P. C. C. Isherwood as Chairman.

PLANT FIBRES, INCLUDING COTTON

Plant fibres have been among the most important raw materials investigated at the Institute. The extensive pioneer work on cotton was carried out in connection with the campaign for the development of cotton cultivation in Empire countries with a view to relieving the dependence of Lancashire upon non-British supplies of raw material, which was inaugurated by the formation of the British Cotton Growing Association in 1902. Briefly, the part played by the Institute was the laboratory examination and the commercial valuation (by a panel of trade experts) of many hundreds of samples of cotton from the experimental cultivations carried out in practically every Colony and Dominion in which the crop was a cultural possibility. The work received the assistance of a Treasury grant which enabled a special assistant (Mr. F. W. Barwick, now Director of the Manchester Chamber of Commerce Testing House and Laboratory) to be appointed for the laboratory investigations. The work, which extended over several years, witnessed the growth of the industries in Uganda, Nigeria and elsewhere by the development of long-stapled and pest-resistant varieties, in the Sudan, Egypt, Queensland, and also the vicissitudes of the West Indian Sea-Island cotton industry. A number of important official reports by the Director (Professor Dunstan) on British cotton cultivation were issued during the period, including one on the results of his visit to Cyprus in 1904; and the comprehensive Empire Cotton Exhibition organised in conjunction with the British Cotton Growing Association at the Institute in 1905 illustrated the current position and the part played by the Scientific and Technical Department in the work. Mr. W. G. Freeman, then Superintendent of the Galleries, visited Nigeria in 1904 to report on the prospects of cotton cultivation.

Investigations of plant fibres other than cotton which continue to form an important part of the work of the Plant and Animal Products Department may be grouped as relating mainly to jute and jute substitutes, rope and cordage fibres, flax, hemp and hemp substitutes. Since 1926 the work has been actively developed in co-operation with the Consultative Committee on Vegetable Fibres, under the chairmanship of Mr. A. Wigglesworth, the Secretary of the Committee being the late Dr. E. Goulding, and subsequently Mr. B. E. Long.

Of the extensive work in this field it is possible here only to mention a few instances. For further particulars reference may be made to the Selected Reports on Fibres (1909), Goulding's *Cotton and Other Vegetable Fibres* (1917, 1919) and the numerous articles and reports in past volumes of this BULLETIN.

The work on sisal hemp has been of great value especially as regards finding new outlets for the fibre. Of outstanding importance in this direction were the prolonged series of trials to determine the suitability of the fibre for use in marine cordage, as an outcome of which sisal ropes even before the war were adopted for use in place of manila ropes for many purposes on H.M. ships. Similar work with equally satisfactory results was also done on phormium fibre (New Zealand hemp).

Efforts have been made to encourage the production of flax in many Empire countries, and special reference may be made to the experiments in Kenya, which although unsuccessful in the first attempt, have now led to a substantial production. Much work has been carried out on Indian sunn hemp (*Crotalaria juncea*) with a view to improving the quality of the product and securing its trade acceptance. Among other fibres examined may be mentioned the bow-string hems, pineapple fibre, palm leaf fibres, pita, coir and kapok and other silk flosses. It has been shown that for use in life-saving appliances Indian "kapok" (*Bombax malabaricum*) if carefully prepared is equal as regards buoyancy to the Java product (*Ceiba pentandra*) and can be used as an alternative to that fibre.

In 1936 an Empire Fibres Exhibition was arranged at the Institute in illustration of the work on these products carried out by the Department and the Committee. A descriptive catalogue, "Commercial Plant Fibres (excluding Cotton)" was prepared for the occasion.

PAPER-MAKING MATERIALS

Recently the Laboratories have been refitted with modern equipment for the examination and testing of raw materials for paper-making which has been the subject of investigations for many years past. Work has been concerned with a variety of materials, e.g. waste wood, cotton stalks, bamboo, grasses, hard-woods and coniferous woods derived from many countries, including East and West Africa, Rhodesia, India and Ceylon, the West Indies,

British Guiana and St. Helena. Special interest attaches to the investigation of bamboos from Kenya, which were found to furnish a pulp of good quality which could be readily bleached and yielded a strong white paper. Economic considerations have hitherto stood in the way of the commercial development of this promising material.

Among the grasses examined was a series of tall species growing abundantly in Nigeria, some of which gave promising results. The question of the utilisation of these grasses for paper-making has recently been revived by the Forest Department.

Among the hardwoods from British Guiana which have been tested, wallaba wood has been found to offer promise for paper-making if economic circumstances permit of the setting up of an industry. Recently the Laboratories have investigated a number of dipterocarp woods (merantis) from Malaya which were found to yield pulps suitable, after bleaching, for certain classes of printing and writing papers. Yawa fibre (*Vigna sinensis* var. *textilis*) from Nigeria recently examined yields an excellent paper for special purposes, and the possibilities of musanga wood from the same Colony have been investigated. The general subject of paper-making materials is of much importance and will doubtless receive further attention after the war. The additional facilities now available should enable the Institute to continue to take a leading part in the new developments.

SILK

Except in India and, to a minor degree, in Cyprus, there is no commercial production of mulberry silk in the Empire. The product, however, has been the subject of repeated experiment, and early in its work the Imperial Institute examined and reported on silk raised overseas, e.g. in Australia, which proved to be of promising quality. In 1916 when, as in the present war, there was a serious shortage of silk supplies, the Institute appointed the Advisory Committee on Silk Production, under the Chairmanship of the late Sir Frank Warner, with Dr. S. E. Chandler as Secretary, to investigate the sericultural and economic possibilities of silk-raising in Empire countries. The labours of this Committee during many years, under its first chairman, who was succeeded by Mr. Norton Breton, proved by means of experimental sericultural work in selected overseas countries, including Cyprus, East and South Africa, the West Indies, etc., that mulberry silk cocoons of excellent quality could be raised and that, as shown by practical trials in the factories of members of the Committee, the silk produced possessed wholly satisfactory technical properties. The Committee early concentrated upon the development of the ancient silk industry of Cyprus which had become mainly restricted to the export of cocoons to France and Italy for reeling. Its object was to establish in Cyprus a local commercial reeling industry. Valuable preliminary

assistance was given by Mr. H. Solman, a member of the Committee, whose firm had operated a filature at Messina, and by Mr. W. Bevan, Director of Agriculture, who furnished estimates of cost of land and buildings. After full inquiry Mr. Norton Breton arranged for his firm to establish in the Island a fully equipped modern filature, for the production of reeled silk from the cocoons. The filature was opened by the Governor in 1926 and the reeled silk produced quickly established itself on the market as a first-class product. Unfortunately, the disastrous fall in the world price of silk in 1931 resulted in the closing of the filature.

In connection with the Imperial Institute Indian Trade Enquiry in 1918 the Committee prepared a report recommending measures for the improvement and development of the Indian silk industry as a source of world supplies; and advised in regard to the improvement of Kashmir silk. Attention was drawn to the need for developing the production of raw silk in the Empire, and in 1926 the Colonial Office circulated a despatch covering a memorandum on the subject prepared by the Committee, to countries likely to be interested.

In 1929-30 Mr. Norton Breton, Chairman of the Committee, visited Tanganyika, Uganda, Nyasaland, Southern Rhodesia, from which countries the Committee had received excellent cocoons, and also the Union of South Africa, to report on the economic possibilities of silk raising. Circumstances appeared not unpromising in one or two cases, but in general the special needs of the industry and the costs of production militated against local success.

The Committee, with the help of much experimental work in the Laboratories, fully investigated the industrial and commercial possibilities of African wild silk (*Anaphe*, *Epanaphe*) and demonstrated its value for the spun silk industry if available at competitive prices. This work has proved of great value in developing the collection and use of the silk for present war purposes.

RUBBER

The investigations on the nature and quality of the various types of African wild rubbers carried out at the Institute in the first decade of this century, and recorded in the Selected Reports on Rubber (1912) and in the Imperial Institute Handbook on Rubber by Mr. Harold Brown (1914), were of fundamental importance, and the results are proving of the greatest value to-day, when Africa is being combed for rubber to help in making up the deficiency due to the loss of the Far Eastern plantations. The officer mainly responsible for the work on rubber was Mr. Harold Brown, who in 1908 visited the Bahr-el-Ghazal (Sudan) and reported on the rubber potentialities of that region. Another member of the staff who was largely concerned with the rubber investigations was Dr. S. S. Pickles, who later went into industry and is now a Vice-President and Colwyn Gold Medallist of the Institution of the Rubber Industry.

Before Hevea became recognised as the most suitable rubber tree for planting, experiments on the cultivation of Funtumia, Ceara, Castilloa, Sapium, Ficus, etc., were conducted in many tropical colonies. The Institute assisted in this work by examining the rubber obtained and by furnishing information and advice on the many technical questions that arose.

The Institute also took a leading part in investigating the many new problems which arose as the Hevea plantation industry developed. In 1913 a Rubber Research Scheme was arranged by the Government of Ceylon and certain planting companies in co-operation with the Institute, which provided for a careful and systematic investigation of plantation rubber. To carry out this work a special rubber-testing laboratory was set up at the Institute and equipped with the latest available machinery. A comprehensive series of experiments was drawn up with a view to determining the effect of various methods of preparing and treating the rubber on its vulcanising and mechanical properties, and an officer (Dr. L. C. Campbell) was detailed from the Institute staff to superintend in Ceylon the work of preparing the samples to be examined at the Institute. In 1920 the scope of the Scheme was extended by the amalgamation with it of the scheme of rubber research carried out independently in Ceylon by the Rubber Growers' Association. A series of reports on this work was published in the BULLETIN OF THE IMPERIAL INSTITUTE between 1916 and 1923 and reprinted under the title *The Quality of Plantation Rubber*. For many years Mr. Harold Brown was Secretary of the Rubber Committee, and he was succeeded by Mr. J. A. Nelson, also of the Institute staff.

Later the scheme was reorganised so as to cover research work carried out in Malaya as well as in Ceylon, and the administration was transferred to a body representative of those two countries, as well as of the Rubber Growers' Association and of certain British institutions. The work, however, is still conducted in the original laboratory at the Institute, with augmented staff and equipment, and is under the superintendence of Mr. G. Martin, who joined the Institute staff in 1922. At the moment, important work is being done on African rubbers and on possible new sources of rubber, in connection with which the staff of the Institute itself is collaborating, especially as regards botanical questions.

DRUGS

Before Professor Dunstan took over the Directorship of the Scientific Department in 1896, he had occupied the Chair of Chemistry at the Pharmaceutical Society's School of Pharmacy, and several of his first staff of assistants at the Institute were trained in that School. It is not surprising, therefore, to find that the investigation of drugs occupied a prominent place in the early activities of the Department. Included amongst that work, the results of which were recorded in the publications of the Royal

Society and the Chemical Society, was a study of certain aconite alkaloids, of the constituents of Indian and American podophyllum, the alkaloids of *Hyoscyamus muticus* of India and Egypt, etc.

An extensive investigation was made of the composition of opium produced in the various opium districts of India. The first report on samples from Jaipur was issued in 1896, whilst a detailed report, embodying the results of all the researches conducted at the Institute, appeared in the BULLETIN OF THE IMPERIAL INSTITUTE in 1915. It was shown that, although there is a wide variation in the amount of morphine present in the opium from different districts, some of the samples examined proved to be as rich as good specimens of Turkey and Persia opium, and some even richer. Therapeutic trials of selected specimens and tests for the manufacture of morphine and codeine were entirely satisfactory.

During the last war a considerable amount of work was done on new sources of alkaloids then in short supply. Amongst these may be mentioned *Hyoscyamus muticus* as a source of atropine and its congeners, and *Datura metel* as a source of scopolamine.

Reference may also be made to the investigation in past years of cinchona bark from Empire sources, including the examination of samples from St. Helena, Nigeria (Cameroons) and Tanganyika, of Indian wormseed (*Artemisia brevifolia*) as a source of santonin, and of African strophanthus seed.

At the present time much attention is again being paid to new sources of drugs and the Institute has been able to offer useful advice to inquirers in many parts of the Empire regarding the cultivation, preparation and marketing of medicinal plants suited to the different countries.

INSECTICIDES

Amongst insecticides of vegetable origin nicotine has, of course, long been recognised as one of the most important poisons for use against certain types of insects, and the Institute has done useful work concerning the production of tobacco of high nicotine content in several of the Colonies. In recent years, however, the tendency has been to employ materials less harmful to man and domestic animals and to the development of these newer insecticides such, for example, as those prepared from Derris root and Pyrethrum flowers, the Institute has given much care and attention. To meet the new situation a Consultative Committee on Insecticide Materials of Vegetable Origin was formed in 1937, with Dr. H. A. Tempany as Chairman, and Mr. H. J. Holman, of the Intelligence staff, as Secretary.

Many samples of derris root of different varieties from Malaya, East Africa and elsewhere have been examined in the laboratories, and advice has been given to producers on the cultivation, preparation and marketing of the roots. As commercial supplies increased the need of an accurate method of determining the rotenone content

of the material became imperative, and after a prolonged investigation the Institute, in conjunction with the Rothamsted Experimental Station, the Cooper Technical Bureau and the Department of Agriculture, Malaya, worked out a standard method, which was published in 1942.

The great extension in the use of pyrethrum, and the development of the Kenya industry, in which the Institute played an important part, has resulted in much analytical work on samples from Kenya and other parts of the Empire. The assistance of the Institute has also been sought by the authorities in many parts of the Empire on questions relating to the cultivation and production of the flowers.

The use of pyrethrum-oil preparations for war-time purposes has necessitated modified methods of analysis, which again the Institute devised in co-operation with Rothamsted.

In 1940 a monograph entitled "A Survey of Insecticide Materials of Vegetable Origin" was prepared at the Institute under the editorship of H. J. Holman.

Apart from these main products the Institute has investigated, often in conjunction with Rothamsted, a number of other materials reputed to be of insecticidal value, of which species of *Tephrosia* and *Mundulea* may be singled out for special mention.

TOBACCO

In many British overseas countries considerable attention has been devoted to the question of producing tobacco suitable for the United Kingdom market, and these efforts have been stimulated particularly during the last twenty-five years by tariff preference accorded to Empire-grown tobacco, and by the rapidly growing increase in the World's consumption. The Imperial Institute has co-operated in this work by furnishing information and advice as to the varieties of tobacco in demand here, and the methods of cultivation and preparation to be adopted; by determining the suitability of soils for the cultivation of the crop; and by examining in the chemical laboratories and submitting to British manufacturers the tobacco produced. Tobacco from practically all parts of the Empire has been examined, from heap-fermented leaf for native use to flue-cured cigarette leaf for United Kingdom consumption. Assistance has also been given in many instances in the disposal of trial consignments forwarded to test the market reception of the tobacco in question.

The Institute was particularly concerned with the early work in Nyasaland, from where the first Empire Bright leaf of note was sent to the United Kingdom market, co-operating with the Department of Agriculture in the experiments which resulted in the establishment of the industry, and subsequently assisting in a series of investigations regarding the manurial treatment of the crop. Rhodesia, South Africa and Canada also became producers of

first-class Empire Bright and Semi-bright leaf ; and Ceylon, in whose experiments considerable assistance was afforded, has grown a Burley type leaf of good quality for export in addition to her production of cigar leaf.

TIMBERS

Colonial and Indian timbers were among the earliest raw materials investigated by the Imperial Institute through its expert referees. The results were recorded in detail in the volumes of the Institute's " Journal " and in summary in " Technical Reports and Scientific Papers." The timbers included large series of specimens from Ceylon, Jamaica, Cape Colony, British Guiana, British Honduras, and Australia, on which mechanical tests were carried out by Professor W. C. Unwin, F.R.S., whilst Mr. Allan Ransome and Mr. Herbert Stone reported on the characters and working qualities of the timbers. Mr. Stone also examined and reported on many specimens of timbers from East and West Africa, India, and elsewhere. Later, the mechanical properties of timbers investigated at the Institute were determined by Professor W. E. Dalby, F.R.S., whilst in 1920 a timber-testing laboratory and workshops were established at the Institute itself. Tests were carried out in the laboratory for nearly 10 years, when that aspect of the work, together with the staff of the laboratory, was transferred to the newly-formed Forest Products Research Laboratory at Princes Risborough. A large number of timbers from many overseas countries were examined as to their mechanical strengths and working properties, the results of the tests being published in the BULLETIN OF THE IMPERIAL INSTITUTE. This work was done in collaboration with the Advisory Committee on Timbers set up in 1916 and still in existence. The late Mr. H. D. Searles-Wood, for many years Chairman of the Committee, was succeeded by Mr. J. P. Fraser. The Secretary of the Committee is Dr. S. E. Chandler. Having in mind that nine-tenths of the timber used in the United Kingdom was imported and mostly of foreign origin, the main work undertaken by the Committee was to bring to the notice of the timber trade and timber users in this country promising new or little-known woods from Empire countries. The method adopted was to select, in consultation with overseas Forest Departments, woods which appeared to have promising technical qualities and to be available in quantity at reasonable prices. Samples were obtained and tested in the Laboratories and the results studied in the light of the practical experience of the Committee who recommended the shipment of trial consignments of promising woods to test the market.

In 1928 the Committee were in a position to issue as an Imperial Institute monograph a " Descriptive List of Some Empire Timbers recommended by the Advisory Committee on Timbers " dealing with some 44 species, and in the same year assisted the Director

(Lieut.-General Sir William Furse) in organising a comprehensive Empire Timber Exhibition held at the Imperial Institute.

Outstanding examples of the work of the Committee, in co-operation with the Imperial Institute, have been the development on the home market of British Columbian softwoods, West African secondary timbers and Malayan hardwoods, and in connection with the Indian Trade Enquiry a report on Indian timbers for the United Kingdom market; while in recent years as a result of trade experience gained over several years the Committee in consultation with the overseas countries concerned prepared and issued (with a second edition in 1937) "Grading Rules and Standard Sizes for Empire Hardwoods (square-edged) intended for Shipment to the United Kingdom."

The work on British Columbia softwoods originated in 1915 from a request to the Director of the Imperial Institute from the Agent-General for assistance in securing the inclusion of the timbers in British Government specifications as alternatives to Baltic softwoods. By arrangement with the Imperial Institute H.M. Office of Works carried out practical trials with the woods in structural works, a shipment of douglas fir, western hemlock and sitka spruce being specially obtained for the purpose. Mechanical tests proving satisfactory the timbers were used in departmental construction work and, after standing, were officially approved. Publication of the facts led to many inquiries and a great impetus was given to the use of the woods by their adoption, on the recommendation of the Committee, by the London County Council in connection with housing schemes. The subsequent use of British Columbia timber by municipalities, contractors and other users was rapid. The campaign was assisted by the favourable results of a special inquiry conducted by the Royal Institute of British Architects, at the instance of the Chairman of the Committee, into an alleged prejudice against the use of British Columbia woods in this country.

The work on West African timbers aimed at developing a trade in hardwoods other than mahogany which had been the mainstay of the Nigerian and Gold Coast export timber trade. The Committee therefore arranged with the Chief Conservator of Forests (Mr. H. N. Thompson) to send to London trial consignments of logs of some dozen selected timbers which were tested in the Imperial Institute laboratories and examined by the Committee. The species finally recommended are now established on the market. In recent years similar action was taken in regard to Malayan timbers, some of which form Empire counterparts of established Philippine woods.

Among the activities of the Committee in other directions may be mentioned the tests of fire-resistance of Empire timbers by the London County Council with a view to their inclusion in the schedule of fire-resisting materials appended to the London Building Acts (Amendment) Act, 1905; and practical trials as sleepers on

British railways of mora timber from British Guiana. Special memoranda prepared in association with the Committee included those on Empire timbers for rifle stocks (furnished to the Royal Small Arms Factory, Enfield), for motor bodies, for decorative and building work, and for aircraft. As a delegate from the Department of Overseas Trade, the Secretary of the Committee in 1931 attended the International Congress on Timber and Forestry held in Paris and read a paper on Empire timbers; and in 1937 broadcast on the Empire wavelength on Imperial timber resources.

GUMS AND RESINS

Perusal of the Selected Reports on Gums and Resins published by the Institute in 1909 indicates the wide range of products of this class which have been examined in the Institute's laboratories. Although this publication only covers a period of about six years it contains, amongst others, reports on soluble gums of the arabic type from the Sudan, West and East Africa, India and Australia, on insoluble gums of the tragacanth type from India, East Africa and the Gold Coast, copals from West Africa, Fiji and Australia, dammars from Malaya and Burma, elemi resins from the West Indies and West Africa, and pine resin from India. At that time Mr. H. H. Robinson was a member of the scientific staff of the Institute and contributed a valuable report on the chemistry of gums at the meeting of the British Association in 1906.

Since then much other important work has been done. For example, in conjunction with the Forest Departments of the Punjab and the United Provinces, an elaborate investigation was carried out on the turpentine and rosin obtainable from the oleo-resins of *Pinus longifolia*, *P. excelsa* and *P. Khanya*. The production of these materials from the first-named species is now an established industry in India. The Institute was the first to show that the oleo-gum-resin of *Boswellia serrata*, an Indian tree, yields an oil closely resembling turpentine oil and a rosin that forms an excellent substitute for American rosin. Another Indian product to which much attention has been paid is lac. This material, together with turpentine and rosin, formed the subject of one of the Reports of the Indian Trade Inquiry and more recently various problems have been investigated on behalf of the Indian Lac Research Bureau in London, work which at the moment is growing in importance.

Recent investigations on the oleo-resin from the Aleppo pine (*P. halepensis*) produced in Cyprus, have shown that that island is a valuable potential source of turpentine oil and rosin of a quality comparable to that of the American products.

Thanks to the initiative of Dr. Drake-Brockman, who collected a comprehensive series of samples of the gums, resins and oleo-gum-resins of British Somaliland (including such products as myrrh, frankincense and bdellium), the Institute was able to publish in its BULLETIN a series of reports recording the investigation of these

products. More recently useful work has been done in ascertaining the causes of the "blocking" of Somaliland gums during transit, a defect which lowered their market value.

Important work has also been done, in recent years, on the gums of Nigeria and Tanganyika and on resins from Malaya and Ceylon.

Since 1938 this work has been carried out in collaboration with the Consultative Committee on Gums and Resins formed in that year under the Chairmanship of Mr. A. J. Gibson, with Mr. H. T. Islip, of the Laboratories staff, as Secretary.

TANNING AND DYEING MATERIALS

In the early days of the Institute many tanning materials of India were surveyed to ascertain their suitability for commercial development, by chemical examination and practical trial in the tanyard. Experiments were also made with a view to improving the methods of manufacturing tanning extracts in India. A large number of Indian plants possessing tinctorial power were also investigated in order to determine the nature and value of the colouring agents present. This work was chiefly conducted in the dyeing laboratories of the Yorkshire College, now Leeds University, and the results were published in a series of valuable papers by the late Professor A. G. Perkin.

When in the last war a considerable shortage of tanning materials was experienced, the Imperial Institute drew the attention of tanners to the wattle bark produced in South Africa, which was then little used in this country although it had found a place in German tanning practice. As a result wattle bark was tried and accepted by tanners, and rapidly rose to the position of being the most important tanning material consumed in the United Kingdom. As the demand grew the possibilities of growing wattle in other parts of the Empire were investigated, and the bark produced experimentally has been examined at the Institute. The analyses made of large numbers of samples of bark from different varieties of *Acacia* and of varying ages, grown in South and East Africa, India, Ceylon and elsewhere, represent a valuable contribution to the knowledge of the subject and form an important store of data for reference.

Amongst the many other materials investigated may be mentioned the widely divergent varieties of mangrove bark from West and East Africa and almost every other part of the tropical Empire. Some of these are of excellent quality, but for economic reasons are not profitably usable outside the district of origin in competition with more favourably placed materials.

Not only has attention been devoted to new products but well-known tanstuffs have come under review. In this category are included the work on the composition of Indian myrobalans, the investigation on the relation between the catechin-content and

the preserving action of Burma cutch, and the successful efforts to improve the quality of sumac produced in Cyprus.

On the recommendation of the Imperial Institute Advisory Committee on Tanning Materials a report was prepared by the staff of the Plant and Animal Products Laboratory and published in 1927-28, which gave a general account of the principal tanning materials of Empire origin, and furnished a convenient summary of the subject. The present Chairman of this Committee is Dr. Dorothy Jordan Lloyd, and the Secretary Dr. J. R. Furlong.

HIDES AND SKINS

The first important work on hides and skins was undertaken during the last war when in 1916, at the request of the Secretary of State for India, a committee was formed to consider the question of finding markets for the large quantities of the light Indian cowhides (kips) which had hitherto been exported to Germany and Austria. As a result of an extensive survey of the Indian industry this committee issued a comprehensive report and recommendations for the development of the trade in November 1919.

In 1927 an Advisory Committee on Hides and Skins was established under the Chairmanship of Sir David Prain, with Dr. J. R. Furlong as Secretary (the present Chairman being Dr. Dorothy Jordan Lloyd). The formation of this Committee marked the commencement of a period of great activity with these products at the Institute—a period in which co-operation on the one hand with Veterinary Departments in overseas countries of the Empire and on the other with tanners, with the hide and skin trade, and with their organisations, has produced results of world-wide interest and importance. In 1932 drying trials with East African hides were carried out in Kenya with the object of ascertaining the conditions which gave rise to the serious putrefactive damage known as "blister." One thousand hides, prepared in various ways, were employed in the experiments, and the results of their examination, including tanning trials carried out by members of the Committee, proved of outstanding importance. It was demonstrated that sundrying, which had hitherto been regarded as injurious, can produce hides almost, if not quite, equal in quality to shade-dried hides, provided free circulation of air on both sides of the hide was assured by suspension of the hide.

A further series of trials on similar lines conducted by the Government of Southern Rhodesia in 1934, the hides prepared in the trials being sent to the Institute for tanning trials and assessment of quality, fully confirmed the previous finding. The International Council of Tanners approved the method of suspension-drying devised by the Committee and recommended its adoption in all countries of the world, in place of the ground-drying process hitherto employed. It subsequently became the officially recommended method in various parts of the Empire for both hides and skins.

Other important work has been carried out in recent years on goat skins from Nigeria and sheep skins from British Somaliland.

In 1937 a monograph, "The Preparation of Empire Hides and Skins," edited by Dr. J. R. Furlong, was issued with the object of increasing the value of the Empire's hide and skin industries by raising the standard of preparation. In 1933, at the time when reptile skins were becoming fashionable for footwear and other purposes, the Committee prepared a monograph, "The Collection of Reptile Skins for Commercial Purposes," which was designed to provide the necessary information for those undertaking the collection of the skins as a new enterprise, and for the guidance of older collectors in avoiding methods liable to produce harmful economic results. At the same time an exhibition of reptile skins, in which the trade concerned actively co-operated, was held in the Galleries of the Institute.

SCIENTIFIC AND TECHNICAL DEPARTMENTS
MINERAL RESOURCES

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INVESTIGATIONS and reports upon the composition, uses and resources of Empire minerals have been carried out at the Imperial Institute since about 1896, one of the earlier officers engaged in this work being Mr. R. L. Jenks, F.I.C., who later became Chemical Examiner (Customs and Excise) to the Government of India. At the start of operations the work consisted principally of the chemical analysis of raw materials, and much useful work was done, the most outstanding being an extensive study of the composition of some of the principal seams of Indian coals then being worked. The results of this work, which had been undertaken at the instance of the Government of India, were published together with other data by order of the Secretary of State for India as a "Report on the Coal Supply of India." Mineral products examined between 1896 and 1900 included coals from Collie, Western Australia, brown coal from Morwell, Victoria, iron ores from the Salem district of Madras, Newfoundland and New Zealand.

The Department entered into a more active life with the appointment in January 1901 of the late Mr. G. S. Blake, A.R.S.M., B.Sc. (later Mineral Adviser to the Government of Palestine) as chemist and geologist to the then Scientific and Technical Department. Single-handed for several years, he did much useful work and was responsible for a large number of analyses of metallic and non-metallic minerals from Canada, India, New Zealand, Newfoundland, Nigeria, Somaliland and the West Indies.

In 1903 the volume and scope of the mineral work developed considerably, largely owing to the foresight and initiative of the Director, Professor (later Sir) Wyndham R. Dunstan, M.A., LL.D., F.R.S. At that time the mineral resources of Nigeria were virtually unknown, and the Director suggested that as a first step to ascertain the facts a reconnaissance, to be termed a Mineral Survey, should be made. As a result Mineral Surveys were sanctioned by the Secretary of State for the Colonies and were carried out under the

¹ Entered Imperial Institute Service in 1903.

² Entered Imperial Institute Service in 1908.

³ Entered Imperial Institute Service in 1921.

auspices of the Imperial Institute in the Southern Provinces from 1903 to 1913 and in the Northern Provinces from 1904 to 1909. Similar Mineral Surveys were also carried out under the auspices of the Imperial Institute in Ceylon (1903-1919), Nyasaland (1906-1909), and Gwalior State, India (1912-1917). Several thousand samples of important minerals collected by the Surveyors were forwarded to the Imperial Institute for chemical and mineralogical examination and technical trials where necessary. The Surveyors' field reports and all the material collected were carefully catalogued and stored and on numerous occasions have proved valuable for reference purposes.

The earlier Surveys naturally led to a large increase in work, and the chemical laboratory staff was augmented first by the addition of Mr. S. J. Johnstone (now Principal of the Mineral Resources Department), and later by other mineral chemists. In order to cope with geological problems the late Dr. J. W. Evans, C.B.E., F.R.S., F.G.S., was appointed in 1904, and was joined in 1905 by the late Mr. Thos. Crook, O.B.E., A.R.C.Sc.I., M.Inst.M.M. (later Principal of the Mineral Resources Department, 1928-1936), who had specialised in economic mineralogy. The number and range of the samples received for examination necessitated further considerable increases in the staff from time to time; and laboratory and office accommodation were provided for the Surveyors whilst on leave in this country, thus affording valuable contact between the laboratory staff and the officers working in the field.

It is only possible here to make brief mention of the valuable work carried out by these Surveys, but summarised accounts were published, at the desire of the Colonial Office, in a series of Colonial Reports (Miscellaneous Series).

In the Northern Provinces of Nigeria, where the field work was carried out under Dr. J. D. Falconer as Principal Surveyor, the tin-bearing granites were examined, and tin was found to be present in alluvial deposits over a wide area. At that time only certain tin deposits in the Bauchi Province were known. Gradually a number of mining companies commenced operations, and subsequently a railway was built, which has resulted in the Northern Provinces becoming one of the chief sources of tin. In 1908 the actual source of the tin in the Eri district was located by the Surveyors in a pegmatite which, on crushing, yielded 20 per cent. of tinstone. An important series of iron-ore deposits was found at Mount Patti, near the junction of the Niger and Benue Rivers. The ore is of great extent, and is covered by very slight overburden, so that it could readily be exploited. It would yield about 50 per cent. of the metal.

In the Southern Provinces of Nigeria, where Mr. J. Parkinson, B.Sc., was Principal Surveyor (1903-6) and was succeeded by Mr. (later Sir) Albert Kitson (1906-11), who afterwards became Director of the Gold Coast Geological Survey, large deposits of high-grade

fuels in the form of lignite and bituminous coal were discovered in several localities and investigated. The bituminous coal of the Udi district was opened up and a railway built, and the coalfield now forms one of the country's most valuable assets. The question of the utilisation of the lignite (of which large deposits occur in several districts) was considered at the Imperial Institute, and briquetting trials without the use of a binder were carried out with success. Doubtless when the need arises these lignite deposits will be capable of producing a large quantity of satisfactory fuel. Associated with these lignites are useful deposits of plastic and refractory clays. The lead-zinc ores of the Abakaliki district were examined and found to be of considerable extent and of good quality so far as base metals are concerned, but the amount of silver was too low to make the deposits worth working at that time. Tinstone concentrates were found at numerous localities, those around Akwa-Ibami averaging 3 lb. of cassiterite per ton. Large deposits of limestones suitable for lime-burning were also found, and clays suitable for pottery and brick-making proved to be abundant in some localities.

In Nyasaland the Mineral Survey was carried out by Mr. A. R. Andrew, B.Sc., and Mr. T. E. G. Bailey, B.A. The chief result was the discovery and investigation of the coal-bearing deposits close to the shore of Lake Nyasa. The coal was found to vary considerably in different fields, that from the Mount Waller area being of the most promising quality and quite suitable for use as a fuel and for the production of gas and coke. Iron ores of fair quality were found in abundance, and flake graphite of good quality was met with. Limestones were examined in great number, and some were found to be suitable for making good hydraulic lime, whilst many were well adapted for burning for building lime, or, if mixed with suitable clay, for producing Portland cement.

In Ceylon, the first Principal Surveyor was Dr. A. K. Coomaraswamy. An early result of the Survey was the discovery and commercial development of the thorium-bearing minerals then urgently required for use in the gas-lighting industry. A new mineral, thorianite, which contains from 60 to 75 per cent. of thoria and much uranium oxide, was first identified as the result of investigation at the Imperial Institute, and although its occurrence was proved to be spasmodic, considerable quantities were exported and sold through the agency of the Institute. Subsequently, at the suggestion of the Imperial Institute, the beach sands of Ceylon were investigated, and these proved to contain the valuable mineral monazite, a phosphate of thorium and the cerium earths, which is used industrially as a source of thoria for gas mantles and of the cerium earths for the cores of searchlight carbons. Preliminary work on the method of concentrating these sands was carried out at the Institute, as a result of which the necessary plant was purchased and sent to Ceylon. This was installed in a factory at

Bentota, and proved quite satisfactory. Other economic minerals also investigated included mica, graphite, and pottery clays.

The object of the Mineral Survey of Gwalior, which was carried out by four geologists under the direction of Mr. D. R. Home, was to examine the mineral deposits already known to occur, in order to decide which (if any) were of sufficient importance to justify their exploitation on modern lines, and also to search promising areas in the hope of finding additional deposits. The preliminary field work lasted from 1912 to 1917, and a large amount of material was sent to the Imperial Institute for examination. Advice was given that in the Gangapur mica mines the methods of mining then employed should give place to systematic vein-mining methods. Deposits of limestone and clay suitable for Portland cement-making were found in the Sheopur district, notably at Kaiaras. A few clays, suitable for making common pottery, were located. The State's chief mineral is building stone, of which there is a large amount available of excellent quality.

In March 1908 the Imperial Institute was asked to advise the Colonial Office on proposals then under consideration for the industrial development of the vast resources of soda available in Lake Magadi, Kenya, but it appeared that the available data on the composition of the surface crust at various depths, and of the underlying brines, was insufficient. At the suggestion of the Imperial Institute the deposits and the surrounding country were examined by Mr. J. S. Coates, B.A. (later Government Mineralogist to Ceylon), who was then completing his term as geologist accompanying the Anglo-Congoese Boundary Commission, and numerous samples were forwarded to the Imperial Institute for examination, the results of this work being subsequently published in this BULLETIN (1923, 21, 431-442). The exploitation of the deposits was commenced in 1911; a factory was erected for the preparation of soda-ash near the lake, and a branch line built to connect with the Uganda railway at Ulu. Production still continues, and in 1939 more than 40,000 tons of soda ash were exported.

During 1911-15 a Mineral Survey of the Mozambique Company's territory in East Africa was carried out, with the approval of the Colonial Office and Foreign Office, under the direction of the Imperial Institute. The Principal Surveyor was Mr. E. O. (later Sir Edmund) Teale, M.Sc., who afterwards became Director of the Geological Survey of Tanganyika Territory, and he was assisted by Mr. R. C. Wilson, B.Sc. (now Director of the Geological Survey of Nigeria). Deposits of coal, limestone, bauxite, iron ore and graphite were located and examined.

Assistance was also rendered to the Geological Surveys which were made of the Falkland Islands, Somaliland and the Windward and Leeward Islands.

The war of 1914-18 caused some temporary changes in the nature of the work of the Department, there being a natural decrease

in the number of samples received for examination from overseas and a very considerable increase in the demand for information both from Government Departments and commercial firms regarding Empire sources of supply and for substitutes for materials no longer available to this country from the Continent of Europe.

In order to maintain better contact with Government Departments and commercial interests an Advisory Committee on Mineral Resources was set up in 1916. The Committee included representatives of the Admiralty, Board of Trade, the London Chamber of Commerce, and also of the sciences concerned with minerals. The late Lord Rhondda was the first Chairman, and he was succeeded by the late Lord Harcourt. On Lord Harcourt's death the late Sir Edmond Slade acted as Vice-Chairman of the Committee.

Many years previous to the formation of the Committee the Imperial Institute had been engaged in collecting and disseminating information on mineral resources, particularly those of the British Empire, and had published periodically in its BULLETIN about forty special articles on the occurrence and uses of various economic minerals. A separate monograph on "The World's Supply of Potash" was published in 1915, and a monograph on "Zinc Ores" followed in 1918. The Committee recommended in its report of 1917 that all the special articles on Mineral Resources hitherto published in the BULLETIN should in future be extended and issued as separate publications. This work made demands which could not be met by the staff, who were already fully occupied, and it was arranged that in certain cases the groundwork of each monograph should be prepared by a specialist selected by the Committee, assisted by the staff of the Imperial Institute which was augmented for this purpose. This step may be regarded as the beginning of the formation of a separate minerals Intelligence Section of the Mineral Resources Department. Between 1915 and 1924 twenty monographs were prepared at the Institute and published by Mr. John Murray.

In 1925, as the result of recommendations made by a committee appointed by the Secretary of State for the Colonies in 1923 under the chairmanship of the Rt. Hon. W. G. A. Ormsby-Gore, M.P. (now Lord Harlech) to inquire into the working and functions of the Imperial Institute, amalgamation was brought about between the Mineral Section of the Imperial Institute and the Imperial Mineral Resources Bureau, an organisation which, in spite of its somewhat chequered career, had carried out much useful work in publicising the mineral resources of the Empire. This amalgamation resulted in the co-ordination of the series of mineral monographs published by both bodies, which had somewhat overlapped, the best features of each being retained in the new volumes.

Several changes in organization were effected, and a separate Mineral Resources Department was formed with Sir Richard Redmayne, K.C.B., M.Sc., M.Inst.M.M., as Adviser on Minerals, a

position which he held until 1935, when for reasons of economy the post was abolished. The Minerals Advisory Committee, enlarged by the addition of a number of members who had served on the Board of Governors of the late Imperial Minerals Resources Bureau, became known thereafter as the Advisory Council on Minerals, the first chairman being Sir Richard Redmayne. The Council includes representatives of home and overseas Governments, geologists, mining engineers and trade experts. The duty of the Council consists in advising the Institute as to the collection, co-ordination and dissemination of information relative to mineral resources: their production, treatment, consumption and requirements; and their development within the Empire, in order that they may be made available for the purposes of Imperial defence, industry or commerce. The present chairman of the Council is Sir William Larke, K.B.E., Controller of Non-Ferrous Mineral Development.

At the same time there were formed fifteen Advisory Technical Committees, each dealing with a group of minerals and reporting its findings to the Council. In 1936 the Committees were renamed Consultative Committees, and several were amalgamated, the number being reduced to the following seven: Mining Law Technical; Coal and Petroleum; Base Metals; Precious Metals; Iron and Ferro-Alloy Metals; Chemical Industries; Miscellaneous Minerals. The Chairmen of these Committees are respectively Professor S. J. Truscott, D.Sc., A.R.S.M., M.Inst.M.M., F.G.S.; J. G. King, Ph.D., D.Sc., F.I.C., A.R.T.C.; Wm. Cullen, LL.D., M.Inst.M.M., M.I.Chem.E., F.I.C.; J. G. Lawn, C.B.E., D.Sc.(Eng.), A.R.S.M., M.Inst.M.M.; Herbert K. Scott, J.P., M.Inst.M.M.; A. E. Dunstan, D.Sc., F.I.C., M.Inst.P.T.; G. H. Tipper, M.A., M.Inst.M.M., F.G.S., and members of the staff act as Secretaries as follows: Mining Law and Chemical Industries, S. J. Johnstone, O.B.E., B.Sc., F.I.C.; Precious Metals and Miscellaneous Minerals, G. E. Howling, B.Sc.; Base Metals, E. H. Beard, B.Sc.; Iron and Ferro-Alloy Metals, A. W. Groves, Ph.D., D.Sc., D.I.C., F.G.S.; Coal and Petroleum, J. Simpson, M.Sc., F.G.S.

Having dealt with the history of the Department from 1896 until 1925, when the present framework was established, it may be useful to give some account of the work carried out by the three principal sections of its activities, i.e. Laboratory investigations and technical trials; Intelligence and Publications; and Statistics.

A more detailed account of the work of the Department will be found in a lecture on "The Services of the Imperial Institute to the Mining Industry," given by Sir Harry Lindsay to the Institution of Mining and Metallurgy, and reprinted in this BULLETIN, 1942, 40, 145 and 210.

LABORATORY INVESTIGATIONS AND TECHNICAL TRIALS

The chemical, assay, ceramic, cement materials, and mineralogical Laboratories of the Mineral Resources Department are equipped

for the technical and mineralogical examination of minerals, ores, solid and liquid fuels, etc., and for small-scale practical trials on raw materials for the manufacture of hydraulic cements, pozzolana, refractories, and ceramic products. The work is carried out in close collaboration with the Intelligence Section, and enables the Department to make full reports on the possible utility and commercial value of the materials sent for examination. When necessary, the opinions of trade experts are obtained to supplement or to confirm the conclusions reached in the Laboratories.

Though no Colonial Mineral Surveys are now carried on under the auspices of the Imperial Institute, Geological Surveys are active in several of the Colonies, and both they and the Colonial Mines Departments are well aware of the help which can be given by the Institute in the solution of many of their technical problems. The Geological Surveys of Nyasaland, Nigeria, and the Gold Coast in particular have in recent years made much use of the facilities available here, and it has largely been in consequence of their demands that the equipment of the Laboratories has been extended in order adequately to be able to meet their requirements. The principal work carried out in the Mineral Resources Department Laboratories for the existing Geological Surveys, for other official and unofficial bodies, and for individuals and commercial firms, may be described briefly, with some examples, under a number of heads.

(i) Ceramics and cement-making materials

This aspect of the mineral work has always been prominent, the Nigerian Geological Survey in particular having been very active in sending samples of clay, etc., for examination. In order to report adequately upon the large number received it was found necessary in 1906 to increase the scope of the technical testing work by installing a small ceramic laboratory, the equipment of which has been gradually expanded until, at the present time, it is possible to carry out small-scale technical trials on materials for making bricks, tiles, drain pipes, earthenware, porcelain and refractories. These trials are designed to ascertain the applications for which the raw materials are most suitable and to determine the best conditions for burning, etc., due consideration being given to local conditions. For these purposes the physical properties of the ware produced, such as tensile, crushing and cross-breaking strength, and porosity, etc., must be determined. Reports have been made on a large number of clays from Australia, the Union of South Africa, British Honduras, Kenya, Mauritius, Nigeria, Sierra Leone, Uganda, etc. Since about 1921 many of the more important investigations on clays for making pottery, bricks, and other ceramic products have been fully recorded in various volumes of this BULLETIN.

During 1917 a laboratory was also set up where burning and

other trials could be made on limestones, clays, etc., for making Portland and hydraulic cement, lime, and pozzolana, the resultant products being tested according to standard specifications in order to compare them with commercial materials. In this way many samples from India, Kenya, Nigeria, Nyasaland, Fiji, Ceylon, etc., have been tested. Some years ago work carried out on cement-making materials from the Central Provinces of India laid the foundations for the establishment of what was probably the first large factory in India to manufacture high-grade Portland cement.

It is a matter of interest that the results obtained in the Laboratories after a prolonged investigation into the possibility of making Portland and natural cements and hydraulic lime from calcareous materials occurring in the bed of Lake Malombe, Nyasaland, were very promising. Though at the time financial considerations prevented the establishment of a local industry the project is again under consideration. Accounts of this investigation were published in this BULLETIN, 1926, 24, 303-318, and 1932, 30, 139-159. An important series of four articles on Cement-Making Materials of the Crown Colonies, published in this BULLETIN in 1924 and 1925, incorporates, amongst other information, the results of investigations carried out at the Imperial Institute on raw materials from these sources, and a comprehensive article published in 1933, 31, 7-30, records the results of an investigation into cement-making materials from Bornu Province, Nigeria.

It may be mentioned that for many years past the Department has been represented on the several Committees of the British Standards Institution which have been concerned with drawing up standard specifications for Portland cements and lime and has taken an active part in co-operative testing work in connection therewith.

A full description of the ceramic and cement-testing laboratories of the Institute, illustrated by photographs, was published in this BULLETIN, 1933, 31, 59-64.

(2) Other non-metallic minerals.

Such important materials as diatomite, quartz, asbestos, graphite, vermiculite, mica, mineral pigments, asphalts, talc, sea-salts, potable and industrial waters, etc., and (from certain aspects of their utilisation) rutile and ilmenite, are included, amongst many others, under this head. Many samples of these products have been examined at the Institute, and it has frequently been possible to put producers having new sources of supply into touch with buyers in this country. The ilmenite industry of Malaya, for example, was initiated with the aid of the Imperial Institute. Samples of ilmenite from elsewhere are periodically received for examination, and much valuable new information regarding the relation between the composition of this mineral and its suitability for the manufacture of titanium pigment has been acquired. More

recently the Institute initiated an active search for Empire supplies of vermiculite, and material from several new sources, examined here, is now in commercial use. A similar search for quartz of optical and piezo-electric quality has also been initiated.

Samples of sea-salt, prepared by solar evaporation of sea-water, from Turks and Caicos Islands and other localities, have been examined, and suggestions have been made regarding methods of improving the quality of the products. An important investigation was carried out for the Ceylon Government in connection with their project to manufacture a number of industrial chemicals from salt liquors, and certain purification processes which were suggested by the Institute proved successful in local practice.

In connection with water-supply investigations in Nyasaland, British Somaliland, and Northern Rhodesia, the mineral compositions of a large number of well, borehole, and spring waters have been determined.

(3) *Metallic ores: ferrous and non-ferrous.*

This category includes a varied assortment of ores, and apart from some of the non-commercial rarities, the Institute may justly claim that there are few metals which the Laboratories have not, at some time or other, had to determine. Among the more useful ores which have been examined may be mentioned a large number of Sierra Leone iron ores, analysed here in the preliminary stages of the development of the important deposits in that Colony. An investigation having a direct bearing on the economics of the bauxite mining industry was recently undertaken for the Gold Coast. A long series of calcination and digestion experiments showed that a reduction in weight of 25 per cent. could be effected by calcination at 400° C. without detrimental effects to the bauxite, and it is a matter to be decided locally whether the difference between the cost of calcination and the freight charges which would be saved would justify the adoption of this preliminary treatment.

At the present time the Institute is co-operating with one of the War Ministries in its endeavour to find new sources of certain ores in this country, and many samples, some of them representing material of good quality, have been examined in the Laboratories.

(4) *Precious metals*

The assay laboratory of the Institute has dealt with many ores containing gold, silver and the platinum metals. Interesting examples of platinum ores have been a native platinum-iron alloy from Abyssinia, examined in 1926 (containing 77.3 per cent. platinum and 1.5 per cent. gold), and platiniferous ilmenite sand from Sierra Leone. A sample of the latter material, said to be tailings from the panning of platinum-bearing black sand deposits from which practically all the platinum had been extracted, was examined at the Institute and found to contain about 12 dwts. of platinum

metals per ton. This sand was reported by a commercial firm to be suitable for the manufacture of titanium pigment, though the presence of a small amount of chromic oxide rendered special precautions necessary in the course of manufacture. The residual sludge resulting from the treatment of the sand for pigment manufacture was assayed at the Institute, platinum metals equivalent to about $1\frac{1}{2}$ oz. per ton of sludge being found. These sands were worked for some time in Sierra Leone for their platinum content, but in view of the amount of this metal found in the discarded tailings, and the suitability of the sand for pigment manufacture, it would appear reasonable to assume that the commercial possibilities of these deposits are not yet definitely exhausted.

(5) *Fuels*

Apart from the coals examined for the Mineral Surveys (see pp. 48-49) samples of solid and liquid fuels from many other sources have also been received and tested. Amongst liquid fuels, for example, crude petroleums from the Gold Coast, Papua, Nigeria and British Somaliland have been examined, the results with the first two mentioned being recorded in this BULLETIN, 1912, 10, 579-583, and 1915, 13, 186-188. In more recent years the development of motor transport using producer gas as fuel has become of increasing importance in places where oil fuel is difficult to obtain or expensive. Samples of charcoal from such localities have been examined at the Institute, and reports, based upon the results of commercial trials, have been made on their suitability for use as fuel for portable producers. Records of investigations made at the Imperial Institute on charcoals from British Guiana and Kenya were published in this BULLETIN, 1930, 28, 139, and 1931, 29, 437, and in consequence of the interest aroused by these articles a more general summary of the information which was then available on producer gas as fuel for motor vehicles was published in the BULLETIN, 1932, 30, 469.

(6) *Soils*

Soil, which is, in general, an intimate mixture of fragments of minerals and rocks, weathered mineral products, decaying vegetation, soluble organic matter, etc., is of common interest to both the Mineral Resources and the Plant and Animal Products Departments of the Institute, and as most of the methods employed in their examination are closely allied to those of inorganic chemistry, they are therefore regarded as coming within the purview of the Mineral Resources Department. A considerable number of soils from Nigeria, Nyasaland, Kenya, the Gambia, Sierra Leone, Zanzibar, Samoa, Malta, Hong Kong, Malaya, British Solomon Islands, Seychelles, Cyprus, etc., have been physically and chemically examined and advice given to Colonial Agricultural Departments

on manurial requirements, as disclosed by the results of chemical analyses, and on the suitability of the soils for particular crops.

This side of the Institute's work had been most active in the years round about 1928, when it became necessary to increase the staff in order to deal with the large number of samples of soil received for examination. During the course of the work inadequacies in certain of the current methods of analysis became apparent, and Miss R. C. Groves, M.Sc., F.I.C., Senior Assistant in the Mineral Resources Department Laboratories, published some original work on this subject, which has proved valuable to Colonial Agricultural Chemists.

In 1930 co-operation between the Imperial Institute and the Imperial Bureau of Soil Science on matters relating to overseas soil problems was established, and it was agreed that in cases where overseas inquirers required soil analyses, they should be referred to the Imperial Institute, where they would have the benefit of experience gained during the preceding 25 years.

(7) Rare minerals

Since the early days of the Ceylon Mineral Survey, when numbers of rare and uncommon minerals were examined (see p. 48), the Institute Laboratories have received many such specimens, and have reached a foremost place among those competent to deal authoritatively with them. Such minerals as euxenite, samarskite, gorceixite, schungite, jarosite, szaibelyite, and variscite, etc., have been identified, and in many instances analysed. Uranium-radium minerals from the Union of South Africa, Australia and Canada have also been examined. Whenever possible, as in the case of euxenite from Canada, endeavours are made to find markets for them. It may be mentioned that the first analyses published of monazite from Travancore and of bismuto-tantalite, a new mineral from Uganda, were made at the Institute. Among the problems awaiting the end of the war is the complete examination, chemical and mineralogical, of what is apparently a new titanium-uranium mineral, the source of which cannot yet be disclosed.

(8) Mineralogical examination of samples

This is an aspect of the laboratory work in which close co-operation between the chemists, mineralogists, and geologists on the staff is essential. The Gold Coast Geological Survey has, in recent years, made much use of the Institute's services in the identification of complex minerals, surface colorations, weathering products, etc. Many of these were very small in amount, but a knowledge of their precise identity was a matter of importance in the solution of local geological problems. Mineralogical examinations of minerals and rocks have always been regarded as of prime importance at the Institute, and in order to deal adequately with the practical problems set before the Mineral Resources Department, a separate

mineralogical laboratory is provided. Improvements and original developments in the technique of mineral examination, devised by members of the staff, are at present awaiting the opportunity for further consideration, and it is hoped that when conditions again become normal it will be possible to make several useful contributions to the sum of present knowledge.

INTELLIGENCE AND PUBLICATIONS

Since its inception one of the functions of the Imperial Institute has been to provide trustworthy scientific and technical advice upon matters connected with the trade and industries of Empire countries for the guidance of Governments, firms and traders and thus to aid in fostering new enterprises and in developing inter-Empire trade. As has already been mentioned, this part of the work was not segregated from the work of investigating samples until the war of 1914-18, when it began to assume considerable importance and proportions and had to be dealt with by a special staff then known as the Technical Information Bureau, which tackled all the problems with which it was confronted whether they related to products of plant, animal or mineral origin. Purely mineral questions, however, were dealt with by qualified geologists and mining engineers. It was during this period that the card indexing of technical and scientific literature received in the Institute's library began to assume great importance for the carrying on of the work. It was also at this time that the policy of disseminating information about the world's mineral resources and those of the Empire in particular by means of the publication of a series of monographs on individual minerals and metals was initiated. This organisation continued until 1925 when, as a result of the fusion of the Imperial Mineral Resources Bureau with the Institute, all matters appertaining to minerals were dealt with by a separate Mineral Resources Department, and it became the function of the Intelligence Section of that Department to collect and index information and to disseminate it both as replies to inquiries and also in various monographs and in the BULLETIN. The monographs on minerals preserved the outward form of those of the Bureau, but they were considerably enlarged and made more comprehensive, particularly in respect of general and commercial information ; and whereas the former Imperial Institute monographs had in many cases been prepared by specialists from outside and edited by the staff, it was found more satisfactory to have the new series prepared by the staff. Monographs on more than fifty minerals or groups of minerals have been published and many have been revised and re-issued several times, but the aim of carrying out a quinquennial revision of the whole series has not been achieved owing to insufficiency of staff. In general each monograph comprises three sections ; the first includes a general introductory statement to the metal or mineral under consideration, a description of its natural

occurrence and distribution, the methods of its exploitation and preparation for market, its properties, industrial uses, grades, marketing and prices, and the world's production ; the second gives an account of the resources of the mineral in all producing countries and in those others in which economic deposits are believed to exist ; and the third is a selected and classified list of references to technical literature on the subject of the monograph. Very great care is taken to ensure that the information is accurate, and before publication each document is submitted to and approved by the appropriate Consultative Committee. These monographs have been well received and very widely quoted. They are freely distributed to Empire Government Departments and are sold to the public at prices sufficient only to cover the printing costs. In addition to the regular series a few special publications have been issued such as that on Mining Royalties and Rents in the British Empire and those on the Mineral Position of the British Empire.

Prior to the publication of the monographs, however, a great deal of information about the mines and mineral resources of the Empire had been published in the BULLETIN OF THE IMPERIAL INSTITUTE which first made its appearance in 1903 and has been published quarterly ever since. Although the format of this publication has naturally changed somewhat through all these years it has usually contained articles, notes, abstracts of recent literature, reports of investigations carried out at the Institute, reports of progress in Colonial development, book reviews, and in recent years a bibliography of the more important references to literature received in the Institute library. Although there have been times when the items devoted to mineral topics have for reasons of insufficient staff been cut down to a minimum the BULLETIN has always contained a proportion of matter dealing with the mineral industry.

By these means the Institute disseminates information on minerals to the public at large, but the greater part of the work is concerned with the giving of information and advice to those who specifically seek it. The policy of the Institute has always been to supply technical and commercial advice, opinions and information generally, not only to Empire Government Departments, but also to firms and individuals, and the service is for the most part given without charge. In years gone by the inquiries came mainly from Governments and officials overseas, but gradually, as it became known to them, individuals and firms in the Empire made more use of this service, and latterly firms in this country seeking to import or export raw materials or manufactured products have also availed themselves of it to an increasing extent. Before the outbreak of the present war the number of these inquiries was running into thousands every year, and they covered almost every conceivable aspect of the mineral industry in its widest possible interpretation. The larger questions dealt with are in the main those in which the Institute is required to prepare reports upon

problems and schemes of development in the Empire at the request of Government Departments both at home and overseas. Of the rest, those emanating from firms and individuals in the Overseas Empire are mostly concerned with obtaining advice about the methods of grading or dressing products to meet the needs of markets, about the industries or firms most likely to provide an outlet for a particular product, about methods of marketing, demands and prices, and the names of manufacturers of various types of plant and machinery or chemical products. Those emanating from the United Kingdom are mainly concerned with possible sources of supply of raw materials. Some relate to the geology and mineral resources of particular areas in the Overseas Empire, the topographical and climatic conditions and transport facilities obtaining there, and to other factors (such as taxation) likely to affect a mining project. Others are concerned with scientific data on the properties of particular products, with advice on the development of new processes and undertakings, with data on the requirements of overseas markets, with advice concerning the most suitable raw material for a particular purpose and with a host of other topics. Inquiries from foreign countries are dealt with only when they relate to Empire minerals and mining or to trade with Empire countries. Among all these, of course, there is always a considerable number of statistical inquiries.

In order to carry out this work efficiently it has been found by experience that the staff must be recruited from men who have not only had a thorough scientific training and obtained a University degree, but also possess a practical and economic as distinct from a purely academic outlook. Some are geologists, some mining engineers, and in both categories there are those who have had practical experience of work in mines or of geological field-work in Empire countries overseas, usually with mining companies. It has been found expedient, too, to allot to each a group or groups of minerals such as the base metals, rare elements, precious metals, iron and ferro-alloys, fuels, refractories, abrasives, etc., in which he takes a special interest and about which, in course of time, he acquires a considerable knowledge, not only through reading textbooks, technical reports and articles, but especially through personal contact with traders in and users of the minerals or metals in his group. The Department owes a great debt to the many individual experts with special knowledge of particular products, both pure and applied scientists and those others engaged in commerce, who are willing to discuss problems that arise from time to time with members of the staff and to give them freely the advantage of their special experience. This applies not only to members of the Consultative Committees, but to many others, and their co-operation is most gratefully appreciated. Great care is taken by the staff to ensure that this gratuitous advice shall not be abused by those who seek to obtain knowledge of their competitors' affairs.

Every item of information likely to be of future interest which appears in the numerous technical journals received in the Library is recorded in a card index by indexers skilled in languages, and often cross-indexed under several headings. Almost every report on Empire minerals is available in the Library together with a large number on foreign occurrences, and a great deal of other information has accumulated on the Department's files of correspondence during the past fifty years. All these are the tools with which the staff is equipped for dealing with its inquirers and compiling its reports and statements. The staff do not regard themselves as experts for they know that success in dealing with such a vast variety of inquiries lies not so much in what they themselves know of every subject as in their knowledge of the best or the most likely sources from which to obtain the facts with the least delay. There is close co-operation between the Laboratory and the Intelligence Sections, for sometimes, before an answer can be given to a question a certain amount of practical investigation must be carried out, and again in other cases chemical analyses often require to be supplemented by commercial information. Moreover, all the mineralogical and petrological investigations are carried out by the Intelligence staff since this includes geologists and mineralogists, and a number of the inquiries relating to chemical matters and certain groups of products, such as cement, are dealt with by the chemists of the Laboratory staff.

The work of answering inquiries is full of variety and of contrast ; it is seldom monotonous and even at times has its humorous aspects. It involves correspondence or interviews with Governors, statesmen, politicians, financiers, scientists, industrialists, inventors, miners, journalists, residents of many different countries ; people of all types, each and every one with a question or a problem. In the course of fifty years the Institute has the satisfaction of knowing from the letters and the lips of many of these inquirers that it has been of much help to them. On a few occasions it has even assisted in the detection of fraud by locating the particular places at which Empire goods in transit across the world have been tampered with. Its one aim has always been to give the maximum of service to everyone who invokes its assistance.

On several occasions, both past and present, the Institute has initiated and devoted considerable attention to the search for certain minerals or special varieties of minerals for which from time to time an urgent need has arisen, relying where necessary on the co-operation of Mines Departments and Geological Surveys of the Dominions, India and the Colonies. The Intelligence Section has also from time to time undertaken the task of bringing the mineral industry of the Empire to the notice of the general public by means of special exhibitions and displays. The first of these was at the Sixth International Mining Exhibition held at the Agricultural Hall in June 1923 in connection with the Mining and Metallurgical

Congress. There was also an exhibit at Wembley Exhibition in 1924-25 and subsequently for several years displays were made at the British Industries Fair, both at the White City and at Olympia. The last and most ambitious exhibition was that held at the Imperial Institute in 1931, when a special collection of the economic minerals of practically every country of the Empire was shown. It was a marked success.

Since the study of Empire mineral problems necessarily involves the study of the world's mineral resources the Institute has been able both in the war of 1914-1918 and the present conflict to aid the war effort considerably by supplying to war-time Government Departments information of various kinds concerning the mines, minerals, plant and products of foreign as well as Empire countries. In fact, for the first six months of the present war, the Mineral Intelligence Section formed a part of the Ministry of Economic Warfare, and subsequently the greater part of the pre-war staff has been seconded to one or other of the war-time Ministries. Of those who remain some are serving on committees set up to deal with special problems connected with the war or with the subsequent rehabilitation of countries at present in enemy occupation.

STATISTICAL SECTION

Prior to 1925 each section of the Institute obtained the statistics it required for the carrying out of its work from the publications in the Library as and when it required them. On coming to the Institute, however, the statisticians from the Bureau were constituted a separate section and charged with the duty of collecting and preparing statistics, whether of animal, vegetable or mineral products, for the use of other sections of the Institute. By far the greater part of the statistical work, however, is concerned with minerals. The Bureau had commenced publishing its annual *Statistical Summary of the Mineral Industry of the British Empire and Foreign Countries* in 1921, and this was continued after 1925 by the Institute with improvements and expansion every year. This well-known annual volume, which in normal times now occupies about 450 pages, is accepted by most Governments and authorities as a standard work of reference and is very widely quoted. It contains the official figures of production, imports and exports of a wide range of metals and minerals in every country from which such data are available and covers the three-year period prior to the date of publication. Publication has of necessity been suspended during the war, but the collection of statistics, in so far as this is possible, continues.

The Section, which is under the charge of Mr. J. J. Endcox, Chief Statistician, also prepares statistics for incorporation in the other publications of the Institute and deals with a large number of statistical inquiries; furthermore, by special arrangement, for a fee, certain firms are regularly supplied with statistics on minerals

of particular interest to them. The facilities available for the supply of statistics have been of much value to war-time Ministries, and this service is in constant demand. A recent development is the service provided by the Statistical Section to Government organisations recently formed for the purpose of planning to meet the situation which will arise in the occupied countries of Europe after the war.

PLATE V.



GROUP OF SCHOOL CHILDREN IN THE EXHIBITION GALLERIES.

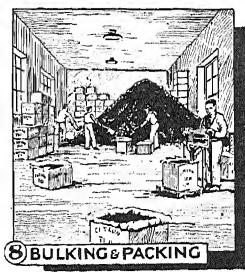
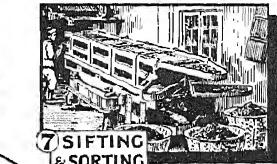
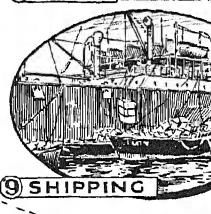
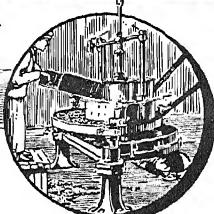
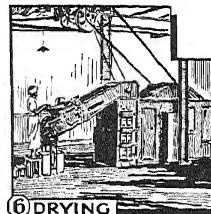
[*By courtesy of the British Council.*]

= IMPERIAL INSTITUTE STORIES of EMPIRE PRODUCTS =

(IX)

CEYLON TEA

from
LEAF CELL
to
TEA CUP



12 TEA TIME

THE EXHIBITION GALLERIES

By H. SPOONER,
Curator, who entered Imperial Institute service in 1906

THE Imperial Institute Galleries and Collections are the outcome of the original scheme proposed by the Committee appointed by H.R.H. the Prince of Wales (afterwards King Edward VII) to suggest the form which a memorial of Queen Victoria's Jubilee should take. As early as 1887 this Committee issued to the public a brief description of the general objects of the Imperial Institute, and made reference to the proposal for Empire collections in the following terms: "It is contemplated to erect a building worthy of the occasion which it is to commemorate and to house in this building carefully selected and arranged collections of the natural and manufactured products of the Colonies and India, side by side with collections of the natural products of the United Kingdom, and every effort will be made continuously to maintain the illustrations of the natural resources of the Empire up to the day." This proposal was incorporated in a clause in The Royal Charter of the Imperial Institute, dated May 12, 1888, which set forth this purpose in the following terms: "The formation and exhibition of collections representing the important raw materials and manufactured products of Our Empire and of other countries, so maintained as to illustrate the development of agricultural, commercial and industrial progress in Our Empire, and the comparative advances made in other countries."

The site occupied by the Imperial Institute building and its Galleries is part of what were formerly the gardens of the Royal Horticultural Society, the lease having been obtained by the Society from the Commissioners of the 1851 Exhibition through the good offices of its President, the Prince Consort. What are now the East and West Galleries were formerly arcades that enclosed the Society's gardens on the east and west sides, the east arcade running parallel to Exhibition Road and the west parallel to Queen's Gate.

Two new Galleries, each with an upper floor, were built to connect the east and west arcades, the total length of the four Galleries—East, West, North and South—being over one-third of a mile. The North Gallery ground floor was reserved for United Kingdom exhibits, the ground floors of the other Galleries and the upper floor of the South Gallery, being devoted to the Indian and Colonial Courts. When the Imperial Institute was opened by Queen Victoria on May 10, 1893, much progress had been made in arranging the collections, the nucleus for most of the Courts being material obtained from the Indian and Colonial Exhibition held in 1886. The Indian collections alone numbered over 7,000 specimens arranged on the system laid down in the *Dictionary of the Economic Products of India* prepared by Dr. (afterwards Sir)

George Watt, C.I.E., and published by the Government of India ; the Indian Government also prepared and issued a guide to the Indian collections and a series of 30 handbooks relating to particular products. The collections in the Colonial sections also numbered some thousands of specimens, but these were of a more miscellaneous character than those of India. Several of the Courts had their own specially appointed curators, whilst the Imperial Institute staff had charge of the remainder. Mr. Harrison Watson, afterwards Trade Commissioner for the Dominion of Canada, was the Curator of the Canadian Court, and Mr. J. R. Royle, C.I.E., Curator of the Indian and Ceylon Courts.

In a brochure entitled *The Facts of the Imperial Institute ascertained upon the Enquiry of a Fellow*, which was issued in 1898, Mr. Charles Langdon Davies describes the collections in the following terms : " In the Galleries of the Institute there is now represented such a view of the peoples, countries, products and resources of the Empire as has never been available before. The Colonial and Indian Exhibition in 1886 was a foretaste of it. Its excellent results showed the founders of the Institute what good they might do, and its brilliant success what hopes they might entertain. An interesting and valuable portion of its collections formed the nucleus of those at the Institute. Important special collections have been sent from India and from a number of Colonies, which receive additions from time to time, and a very extensive and representative exposition is the result."

Interest was, moreover, stimulated from time to time by holding special exhibitions in the North Gallery and the adjacent quadrangles in accordance with another clause in the Royal Charter which had for its purpose " the advancement of trades and handicrafts by exhibitions of special branches of industry and commerce, and of the work of artisans and apprentices." As early as 1892, when certain portions of the Institute were first opened for the use of the Fellows, a small exhibition of Indian art metal-ware was arranged, a contribution by H.H. the Maharaja of Jaipur of a representative collection of the products of his State forming the nucleus. This was followed by an exhibition of China, Pottery and Glass Industries, which included a collection showing the condition of those industries in India.

In 1895 was held an exhibition " illustrating the progress of the science and art of photography from its conception to the present day," and the same year saw an exhibition of Railway Appliances and Inventions, held concurrently with the International Railway Congress at the Institute ; also an exhibition in connection with the International Geographical Congress then in session for the first time in England. All these were very successful in attracting considerable public interest.

In 1896 the first International Exhibition of Motoring was held at the Institute by arrangement with the Motor Car Club. The

exhibits included "the very latest developments of motor carriages of all descriptions, propelled by the agencies of oil, steam, electricity, or compressed air, as well as the practical applications of motors to tramway cars, locomotives, fire engines, street cars, omnibuses, phaetons, cabs, quadricycles, tricycles and bicycles, carriages of every kind; marine, stationary and portable motors of every description, as well as electric and other installations." These were shown in the North Gallery and practical demonstrations of motor cars took place in the South West quadrangle.

In 1897 was opened the Yachting and Fisheries Exhibition, which was a great success. The exhibits included hundreds of models of yachts and was made gay by the display of owners' flags, cups, prizes and trophies. Fishing towns and Inland Fisheries were represented, and the exhibits included contributions by Trinity House, the Meteorological Office, the Board of Trade and the National Lifeboat Institution. A popular feature was a Feu Eclair lighthouse lantern, erected in the south-west quadrangle, which was illuminated each evening from dusk till closing time.

In 1898 there was an "Exhibition of Acetylene Gas apparatus in operation for the generation of acetylene gas from calcium carbide, and its application to the illumination of buildings." This exhibition formed the subject of a Report by a Special Committee appointed by the Society of Arts. During this year was also arranged an exhibition of a selection from the gifts and addresses presented to Queen Victoria, including Colonial and Indian addresses, together with some of the more interesting oriental presents received on the occasion of Her Majesty's Diamond Jubilee.

Then followed, in 1899, the Ecclesiastical and Educational Art Exhibition during the period of the first sitting in London of the Church Congress; and in the same year the eleventh Universal Cookery and Food Exhibition was arranged by the Universal Cookery and Food Association. This was followed in 1900 by the English Education Exhibition, and in 1902 by an exhibition of the gifts and addresses presented to their Royal Highnesses the Prince and Princess of Wales (afterwards King George V and Queen Mary) during their Colonial Tour in 1901. The collection was placed in the North Gallery, where the wedding presents to the Prince and Princess (then the Duke and Duchess of York) had been exhibited.

In July 1902 an Act (the Imperial Institute (Transfer) Act, 1902) was passed "to provide for placing the Imperial Institute under the management of the Board of Trade, and for other purposes." By this Act the Royal Charter was revoked, but the clause relating to the purpose of the Galleries was retained.

On September 6, 1902, the death occurred of Sir Frederick Abel, Bart., G.C.V.O., K.C.B., D.C.L., F.R.S., who had been the Honorary Secretary and Director of the Imperial Institute since its inception, and he was succeeded as Director in the following year by Professor (now Sir) Wyndham R. Dunstan, F.R.S., at that time Director of

the Scientific and Technical Department of the Institute. The Indian and Canadian Courts continued to have their own Curators for a time after the reorganisation of the Institute, Mr. C. E. Jones, B.Sc., F.L.S., being Curator of the Indian Collections until 1907, whilst Mr. Harrison Watson retired from the Canadian Curatorship about two years before that. In 1903 the post of Superintendent of the Colonial Collections was created, the first occupant being Mr. W. G. Freeman, B.Sc., A.R.C.S., F.L.S., afterwards Director of Agriculture, Trinidad. He was succeeded in 1911 by Dr. S. E. Chandler, now Principal of the Plant and Animal Products Department, and the present Curator took charge in 1920.

Under Professor Dunstan's Directorship the various Courts in the galleries were maintained and extended, the exhibits being much on the same lines as hitherto with the addition of new material sent direct from the countries concerned or obtained as a result of the special exhibitions that were held from time to time, such as the Paris Exhibition, 1900, the St. Louis Exhibition, U.S.A., 1904, the Colonial and Indian Exhibition (Crystal Palace), 1905, the Franco-British Exhibition, 1906, the International Rubber Exhibition, 1907, the Festival of Empire Exhibition (Crystal Palace), 1911, and the Rubber and other Tropical Products Exhibition, 1921.

The Courts were further used for the display of examples of raw materials examined in the Scientific and Technical Department of the Institute, with reports as to their commercial value by merchants and manufacturers. In 1903 a collection of Irish Building Materials and Minerals was exhibited by the Department of Agriculture and Technical Instruction for Ireland, and in 1905 a special exhibition was held, in conjunction with the British Cotton-Growing Association, to illustrate British cotton cultivation and the commercial uses of cotton.

An attempt was also made at this time to present the collections more attractively to the general public and to school children ; a Central Stand was installed in the South Gallery to facilitate the supply of information to inquirers and for the sale and distribution of literature ; and conducted educational tours were instituted, the first official Guide Lecturer being the late Dr. H. B. Gray, who was appointed in 1915.

In order to provide colour as well as interest in the various Courts throughout the Galleries a special feature was made of the Royal Presents and Addresses lent for the purpose by King Edward VII and later by King George V and Queen Mary. These included gifts and addresses made to Queen Victoria on the occasion of the Jubilee celebrations of 1887 and 1897, and coronation and other gifts and addresses made to King Edward VII and to King George and Queen Mary. The Indian presents in particular made a popular appeal and were valuable not only for the precious metals and rare woods in which many of them were wrought, but also as showing the influence of European ideas on Indian art ; the addresses also

were in many cases fine examples of calligraphy and the art of illumination. A special exhibition of the Robes worn by King George V and Queen Mary at their Coronation was held in 1911.

As an outcome of a visit by Professor Dunstan to Ceylon, the Ceylon Planters' Association provided funds for building an annexe to the Indian Pavilion to serve as a Tea Room for making better known Ceylon low-country tea, and for the display of Sinhalese industrial art. This was opened in 1914.

During the War of 1914-18 certain of the Exhibition Galleries were requisitioned for use by the War Office and the Ministry of Food, and in consequence the showcases and exhibits were withdrawn and stored in the subway leading from the Institute to South Kensington Station, and in certain private houses in the immediate neighbourhood. This dislocation of exhibits curtailed much of the Galleries work, and it was not until 1920 that the reinstallation of the exhibits in the occupied Galleries became possible.

Meanwhile, on April 18, 1916, Royal assent had been given to "a Bill to provide for Transferring the management of the Imperial Institute from the Board of Trade to the Colonial Office, and for other purposes connected therewith." This became the Imperial Institute (Management) Act, 1916, and made no alteration in the clause relating to the purposes of the Exhibition Galleries which continued to serve two objectives—as showrooms for the display of economic products of the Empire to the technical inquirer and for educative purposes to interest school children and the general public.

In 1923 preparations were afoot for the British Empire Exhibition which was opened at Wembley in the following year, and as a result the Galleries were drawn upon by a number of the participating countries for the loan of show-cases, pictures, photographs and ethnological exhibits, and for specimens of timbers, vegetable products and minerals, and this withdrawal of equipment and material seriously depleted some of the Courts. The success of the Wembley Exhibition 1924, led to its being continued during 1925, and it was not until the following year that the exhibits were reinstated.

As an outcome of a Report by a Commission of Enquiry appointed by the Secretary of State for the Colonies in 1923, and of a resolution of the Imperial Economic Conference, a further Act of Parliament (the Imperial Institute Act, 1925) was passed which repealed the Acts of 1902 and 1916 and provided for the transfer of the Institute to the control of the Parliamentary Secretary of the Department of Overseas Trade. Under this Act the main purpose of the Galleries became public information and instruction, the clause giving effect to this purpose reading as follows: "to maintain for public information and instruction in the Exhibition Galleries of the Imperial Institute exhibitions illustrative of the resources and development of the Empire and of its scenery, life and progress, and where practicable to organise from time to time temporary exhibitions of a similar nature elsewhere." A new chapter in the story of the

Galleries was thus opened. Shortly after the passing of the Act, Lieut.-General Sir William Furse, K.C.B., D.S.O., was appointed Director, and took up his duties on January 1, 1926.

The Wembley Exhibition had shown that the general public was prepared to take a keen interest in the economic development of the Empire and in the life of the peoples who comprise it. Moreover, the Wembley Exhibition had itself provided many new and practical ideas whereby exhibits which are in themselves dull and prosaic may be woven into stories which are both attractive and informative. These methods, adopted at the Institute, served as an inspiration in the task of reorganising the collections for the use of the general public, and more especially for school children.

In order to inaugurate this educational scheme a meeting was held at the Institute on September 28, 1926, which was attended by some 1,200 teachers from the London area. During the following year the Ceylon tea room was, through the generosity of the Empire Marketing Board, adapted for use as a Cinema for the display of Empire films. This valuable adjunct to the Galleries provided an additional form of visual instruction and an attractive medium for spreading a knowledge of the countries of the Empire.

At this time in the Sudan Court were three illuminated picture models (now called dioramas) supplied by the Sudan Government, one of which had been specially made for the Institute and installed in 1916, and the other three transferred from the Sudan Court at Wembley in 1925. The earliest model showed a grain market on the Nile, and the other three represented, respectively, a Kordofan gum market, camel transport of cotton, and a distant view of Port Sudan, with natives of the Red Sea Hills. These models were seized upon by Sir William Furse as the type of exhibit likely to make an appeal both to adults and to children, and he aimed at having at least one of this type of exhibit in each Court to serve as a focal point around which to group the showcase exhibits of economic products. The construction of new dioramas called for by this programme was at once put in hand; the services of the artists responsible for the design and construction of the Sudan prototypes—Mr. R. T. Roussel and Mr. Ernest Whatley—were secured; a studio was provided at the Institute for them to work in; and the workshop of the Institute supplied the necessary framework for the models as well as the cabinets in which to house them when completed. Later a panel of diorama artists was formed by the addition of Mr. Herbert Rooke, Mr. H. Cawood, and Mr. Montague Black, with occasional help from other artists.

The diorama is a subtle combination of picture and model which presents, in miniature, a scene just as it would appear to an observer on the spot. By a clever use of perspective and careful illumination, the contour of a country, the objects in the foreground, and even the atmosphere are portrayed in a manner that leaves little to the imagination. Not only natural scenery but also local life

PLATE VII.



STATUETTE OF JOHN CABOT.

PLATE VIII.



DIORAMA OF MOUNT EVEREST,

and industries—agriculture, forestry, mining and animal husbandry, lend themselves admirably to this method of “visual instruction,” a method which combines artistic treatment with accuracy of technical detail (see illustrations facing pp. 18 and 69).

The number of dioramas on view in the Exhibition Galleries is now 130, most of which had been installed before Sir William Furse's retirement in 1934. Other pictorial exhibits comprise photographic transparencies in the windows, painted friezes, posters and pictures on the walls. Beautifully worked banners made by the Royal School of Needlework, bearing the crests or badges of the various Dominions and their States or Provinces, the States and Provinces of India, Burma and the Colonies, hang in the Courts. In addition relief maps have been introduced to supply, in a more graphic form than the ordinary wall-map, information as to the world situation, contour and physical features of the various Empire countries. Coloured graphs, charts and flow-sheets are also used to show the production, trade, and ultimate utilisation in industry of the more important Empire products, with a view to illustrating the fact that producers and consumers are co-partners, although they may be living in countries widely separated.

As a means of conveying the romantic history which underlies the expansion of the British Empire, it was decided to install statuettes of pioneers or Empire Builders, each in its appropriate Court. This scheme was initiated by the acquisition of a bronze statuette of Cecil Rhodes, one-half of life-size, by Mr. John Tweed, the sculptor, who later presented two original sketch models, one of Captain Cook and one of Lord Clive. Twelve additions have now been made to the original three statuettes and the collection now includes the following :

Canada.—General Wolfe (1727-1759), the hero of Quebec.

Captain George Vancouver (1758-1798). Explorer and Navigator.

Newfoundland.—John Cabot (1450-1498). Discoverer of Newfoundland. (See illustration facing p. 68.)

British Guiana.—Sir Walter Raleigh (1552-1618).

Australia.—Captain James Cook, R.N. (1728-1779). Navigator and Explorer.

New Zealand.—John Robert Godley (1814-1861). Founder and Administrator of the settlement of Canterbury on a plan drawn up by Edward Gibbon Wakefield.

Sarawak.—Sir James Brooke, K.C.B. (1803-1868). First Rajah of Sarawak.

Malaya.—Sir Stamford Raffles (1781-1826). Founder of Singapore.

India.—Lord Clive (1725-1774). Founder of British India.

Mauritius.—Mahé de Labourdonnais (1699-1753). Governor of Ile de France (Mauritius) and the introducer of sugar-cane cultivation in that Colony.

South Africa.—Johan van Riebeeck (1618-1677). The founder of Cape Colony.

Rhodesia.—Cecil John Rhodes (1853-1902). Founder of the Rhodesias.

East Africa.—David Livingstone (1813-1873). Doctor-missionary and Explorer.

Lord Delamere (Hugh Cholmondeley) (1870-1931). Pioneer of the White Settlers in Kenya.

Anglo-Egyptian Sudan.—General Charles Gordon (1833-1885). The first Governor-General of the Sudan.

In 1927 there was held in the Exhibition Pavilion of the Institute the first Armistice Week Exhibition of the work of disabled service men, and this became an annual event until the outbreak of the World War in 1939. Also in 1927, in co-operation with the Rubber Growers' Association, an exhibition of rubber was staged which illustrated all phases in the cultivation and preparation of plantation rubber, and included a display of the rubber investigation work carried on at the laboratories of the Institute, as well as examples of rubber manufactures which play an important part in everyday life.

This was followed in 1928 by an exhibition of Empire timbers, chiefly of those timbers which had been investigated and reported on by the Imperial Institute Timbers Committee and recommended for use in industry to replace timbers of foreign origin. In addition to specimen planks numerous manufactured goods were on view to demonstrate the utility of these woods and their working qualities.

An exhibition of drawings by African students of the Prince of Wales's College at Achimota, Gold Coast, was staged in 1929, and the same year saw an exhibition of the Arts and Crafts of British Columbia Indians lent for this purpose by Mr. A. C. Bossom, M.P. In 1930 an exhibition of printed books was organised by Linotype and Machinery, Ltd., to demonstrate to printers and publishers and the general public the part played by the linotype printing machine in modern book production; and in the same year an exhibition was promoted by the executive of the United Tanners' Federation, to show the extent to which the shoe and leather industries draw their raw materials from Empire sources.

Then followed two exhibitions which created more than usual interest, namely an exhibition of Empire minerals in 1931, and the Reptile Skins Exhibition in 1932. The former brought together specimens of minerals from all parts of the Empire, and, with them, specimens drawn from the Galleries. The collection formed a most striking and impressive display of the vast wealth and variety of mineral products obtainable within the Empire. Manufactured goods were also exhibited to illustrate new or little known uses of certain metals and alloys. The Reptile Skins Exhibition, which illustrated the work of the Imperial Institute Advisory Committee on Hides and Skins, was notable for the novelty of the exhibits, and their attractiveness to the ordinary visitor. Eighteen

firms of merchants participated in the display of raw and finished skins, and thirty-five firms of manufacturers contributed finished goods to demonstrate the value of these skins for decorative purposes and their use in the preparation of "fancy" goods, articles of clothing, shoes, belts and upholstery.

As a result of negotiations with the Royal Commissioners for the 1851 Exhibition, the Upper East Gallery was set aside as an Imperial Gallery of Art for the exhibition of the work of selected artists from all parts of the Empire; and also for exhibiting and judging the work submitted by candidates for scholarships at the British School at Rome. In this Gallery, in 1928, the West African paintings by Mr. Spencer-Pryse were displayed, in co-operation with the Empire Marketing Board, and in 1934 were shown the original drawings for the posters issued by the Empire Marketing Board. From these exhibitions, selections of paintings and drawings were obtained that now form part of the permanent display in the Galleries. Small exhibitions of paintings and sketches made in Labrador and in South Africa were also held in this Gallery.

Towards the end of 1934 Lt.-General Sir William Furse retired and was succeeded by the present Director. Special exhibitions in the Pavilion and the Imperial Gallery of Art have been continued in addition to the annual Armistice-week display of the work of war-disabled men, and the annual exhibition of the work submitted in connection with the competitions for scholarships at the British School of Art at Rome.

In 1935 the President and Governors of the Imperial Institute gave a reception to the Delegates of Legislatures of the Overseas Empire attending the Conference of the Empire Parliamentary Association of that year. Their Majesties the King and Queen (then the Duke and Duchess of York) attended this reception; and indeed, Their Majesties have honoured the Institute on many occasions with their presence, and have regularly visited the Armistice Week Exhibition of the work of disabled Ex-Service men in the Exhibition Pavilion of the Institute. Royal gifts displayed in the various Courts illustrate the excellence of the arts and crafts of the Overseas Empire.

Exhibitions were arranged in 1935 by the National Camping Association and the Cement Marketing Board, followed in 1936 by exhibitions of Empire Children's Art, Public Schools' Art, and by a Young People's Exhibition arranged by the General Post Office. In 1936 was also held an exhibition of Commercial Plant Fibres (other than cotton), organised by the Plant and Animal Products Department of the Institute, designed to show the resources of Empire countries in plant fibres of all kinds used in the manufacture of textiles, ropes, cordage and twine, and in brush-making and upholstery and for other purposes, and in particular to show the interdependence of the Overseas Empire producer and the United Kingdom manufacturer.

In 1937 was staged an exhibition of the Addresses and Messages received by Their Majesties King George VI and Queen Elizabeth from the Colonial Empire on the occasion of Their Majesties' Coronation. In the words of Lord Dufferin, who opened this Exhibition, "these messages and addresses displayed here have come from widely scattered territories all over the world, comprising an area of over 2,000,000 square miles inhabited by nearly 60,000,000 people of different race, colour and creed, and they describe in a most striking way the intense enthusiasm which the Coronation of Their Majesties has aroused." A "Schoolboys' Own" Exhibition was held the same year during the Christmas vacation. During the following year the Director of Medical Services in Kenya staged an exhibition of photographs illustrating African Progress in Kenya especially designed to show the part played by Africans in the work of the Medical Department in Kenya. This year also saw an exhibition of Sporting Trophies arranged by the British Section of the International Exhibition held in Berlin ; a Camping Exhibition, and an exhibition of British Handicrafts organised by the Home Arts and Industries Association.

In 1939, at the request of the Governor of Uganda, a special exhibition was arranged of pictures by Africans of Uganda, Zanzibar, Kenya and Tanganyika, supplemented by examples of modern handicrafts and photographs of African craftsmen, the whole designed to show the important developments now taking place in the field of education in East African countries.

When the Galleries were repainted throughout in 1935, a new colour scheme was adopted whereby different tints were used for the walls and show-cases to give a distinctive note to each Court. At the same time, a new scheme of grouping the Courts was carried out so as to give them a closer geographical sequence. The visitor now passes by natural transition from Canada in the West Gallery, to Newfoundland, the West Indies, New Zealand, Australia, Hong Kong and Malaya in the South Gallery ; India, Burma and Ceylon in the East Gallery ; the Union of South Africa, the African Colonies, Palestine and the Mediterranean in the North Gallery.

The Courts having been re-grouped, the problem of displaying economic products more attractively, intelligibly and comprehensively was again tackled, the outcome being the "story" exhibit, which involved a new technique in display methods. The staple economic products of the Empire, each in its appropriate Court, are shown in all stages from the raw material to the finished article, the sequence of processes being linked by guide lines so that the eye of the observer is led from the "start here" label to the finished article, which may be, for example, a foodstuff, an article of clothing, or some household commodity in everyday use. Each of these stories connects some well-known object of everyday life with the oversea product from which it has been derived and serves to link together the interests of the primary producer with those of the

merchant, the manufacturer and the consumer. Exhibits on these lines are now a feature of the various Courts throughout the Galleries.

In order further to incite interest in, and to give attraction to, these economic displays, lifelike models of the plants which yield the raw materials have been introduced wherever possible. These not only add a note of colour but also give a more accurate conception of economic plants than is conveyed by photographs and drawings, or by dried or otherwise preserved specimens of the plants themselves.

A new scheme has also been evolved for making the numerous photographs of scenery and local life more valuable educationally by arranging them in the form of a travelogue or picture tour of the country they illustrate, in association with a map. So arranged, the map forms the central feature on a screen or wall, and around it are grouped the photographs in their geographical order; each photograph is numbered, and a corresponding number on the map locates the scene portrayed, thus enabling the viewer to form a fairly accurate mental picture of what the country looks like, what are its industries, and who the people are that inhabit it.

In a central position near the Public Inquiry Stand is a new Colonial Empire Annexe—a meeting-place for schools and organised parties before starting on a conducted tour. Here the central feature is a large illuminated map of the Colonial Empire which, by means of press buttons, shows the location and products of the different Colonies—a never-failing source of amusement and instruction to young and old alike. On two sides of the map are installed ten batteries of automatic machines (stillographs) which display series of illuminated photographs of life in the various colonial countries; two similar machines (informographs) supply information regarding a particular country or its products in response to press-button requests. In this Court is also shown a collection of the current issues of Colonial postage stamps.

Unfortunately, in 1939, for the second time in their history, war again intervened, and although on this second occasion the Galleries have not been requisitioned for war purposes, it became necessary shortly after the outbreak to close them to the public as a precautionary measure owing to intensive enemy bombing. Moreover, most of the schools which provided the greatest number of visitors had been evacuated to the country. During the period of closure the exhibits have been kept intact, and the work of improving and modernising the displays has continued. The usual facilities for visits by organised parties have been given and have resulted in the attendance of large numbers of British, Dominion, Indian and Colonial troops stationed in the London area, and also of parties of nationals of most of the occupied countries. (See illustration facing p. 19.) These foreign and overseas visitors have all shown a keen interest in the displays in the Galleries and an appreciation of the

aims and achievements of the British Commonwealth of Nations which they illustrate. The Galleries were re-opened to schools and the general public on December 14, 1942. (See illustration facing p. 62.)

It will be seen from the foregoing record of the work of the Exhibition Galleries during the past fifty years that the original proposal of the founders of the Imperial Institute "continuously to maintain the illustrations of the natural resources of the Empire up to the day" has been consistently observed, although the methods adopted to this end have been changed from time to time to meet changed conditions and the advances of knowledge. From being devoted primarily to the display of an index collection of the Empire's commercial resources the Galleries have now become "The Storyland of Empire." The old criticism that the Institute was remote and difficult of access no longer holds good in view of modern travelling facilities, and year by year the parties from schools and educational institutions who visit the Galleries have increased in number and have come not only from the London area and the Home Counties but from places much farther afield.

South Kensington is now an important educational centre; it is the home of several of the national museums, and with these the Imperial Institute Exhibition Galleries form a useful connecting link. The brochure of 1898, mentioned earlier in this article, contains a passage which is no less true in its application to the "Storyland of Empire" than it was when first written: "The visitor passing from Court to Court sees around him pictures of the peoples and the countries, specimens of their industries, samples of their products, illustrations of their trades, their handicrafts, their modes of life, and is enabled to form a conception of his fellow-subjects such as he could not obtain in the same time or with the same facility in any other place."

THE LIBRARY

By F. HENN,

Librarian, who entered Imperial Institute service in 1898

THE growth of the Library at the outset was very rapid and testifies to the great interest taken, in many influential quarters, in its formation. Within one year of the opening of the Institute the number of volumes on the shelves amounted to some 9,000, the principal donors being the Colonial Office, the India Office, and the Governments of the Colonies and India. Many learned and other societies presented their proceedings and transactions, private individuals donated many volumes, and authors and publishers sent copies of their books.

In these early days of the Institute, when it had a strong social side, there were provided for the use of Fellows, in addition to

the Library proper, News and Reading Rooms where books and periodicals of a general and topical nature could be seen, as well as Writing and Smoking Rooms. With regard to newspapers, for instance, nearly all the British Colonies and Dependencies were represented, and in addition 25 provincial and 55 daily and weekly London papers were provided. A Commercial Reading Room, equipped with a large and extensive selection of British and Colonial trade journals, market reports, etc., was also available, for even in these early days the Library was frequently consulted by business men and others requiring information respecting the Colonies and India and had already shown that it was equal to most of the demands on its capabilities.

But with the cessation of the social activities of the Institute in 1902 much of the material of a general nature was disposed of, and the Library has gradually developed into a specialist collection of material designed to serve the more serious demands of the Institute. The funds available for the purchase of books and periodicals has always been very limited, but the Library has been fortunate in receiving the publications issued by the various Empire Governments, whilst a large number of periodicals are received in exchange for the *BULLETIN OF THE IMPERIAL INSTITUTE*.

The growth of the Library has been steady and continuous and it now contains some 80,000 volumes, exclusive of periodicals, of which some 900 were regularly received up to the commencement of the war period. Although concerned mainly with the Empire, foreign works are well represented and include the chief technical publications of the United States, European countries and their Colonies. It is naturally very strong in the publications of the Overseas Empire Governments and in most cases includes complete sets of their agricultural, forestry, veterinary and mining journals, bulletins, etc., as well as many long runs of the annual reports of the technical departments, trade returns, and other publications relating to raw materials.

Most of the material in the Library is arranged on a geographical basis, with a special section for technical works not related to any particular country. Small libraries of a specialised character are attached to the Laboratories for the convenience of the staff working there.

Although nowadays the Library is essentially a reference library for the use of the scientific and technical staff of the Institute, the Reading Room is available for the use of visitors and in special cases accommodation is furnished to those desiring to undertake a prolonged piece of work. Library visitors have the advantage of contact with specialised scientific officers and in this respect, as Dr. E. H. Tripp, former editor of the *Journal of the Society of Chemical Industry*, stated in a paper read before a Conference of the Association of Special Libraries and Information Bureaux, the Institute Library is quite exceptional.

BULLETIN OF THE IMPERIAL INSTITUTE

VOL. XL. NO. 2.

APRIL-JUNE, 1943

THE STORY OF THE IMPERIAL INSTITUTE¹

*A Broadcast by the Rt. Hon. Harcourt Johnstone, M.P.,
Secretary of the Department of Overseas Trade, and Presi-
dent of the Board of Governors of the Imperial Institute,
transmitted in the 1 p.m. Home Programme of the B.B.C.
10th May, 1943*

FIFTY years ago to-day Queen Victoria opened the Imperial Institute. To many of us, the Institute, in spite of its thousands of visitors, is almost unknown though it is not only the central source of information on the natural and industrial resources, the arts and crafts and education of every part of the Empire, but a fascinating permanent exhibition designed to give a vivid and picturesque idea of the history and the scenery, the everyday life, the art and industry of the Dominions and Colonies. There you can see every kind of raw material, many of them most strange and interesting, in all stages of manufacture into the finished article ; there are wonderful specimens of primitive art or applied science, fantastic costume or industrial technique ; dioramas exquisitely modelled and painted and lit, showing the growth and harvest of crops, the craft workers at their tasks in village or town ; then mining, sheep-shearing—what you will— ; the forests and flowers, the plains and hills, all so lifelike in cloud or sunshine that you might be walking down the village street yourself or watching the birds or admiring the energetic growth of some great Dominion industry. This invaluable work in popular education is not confined to the great galleries of the Institute in South Kensington. It is spread throughout the country by means of the Institute's Film and Lantern Slide Libraries and the Empire Lecture Scheme for schools which has given tens of thousands of children their first idea of the reality and romance of the Empire overseas.

But the chief work of the Institute is in the realms of industrial science. It is the central authority on every class and variety of

¹ This and the two following Broadcasts are printed by kind permission of the British Broadcasting Corporation.

raw material, animal, vegetable or mineral, to be found within the Empire. Always it has played the part of pioneer in this field. Rubber, cotton, timber, leather, oilseeds, iron and steel, lead, etc.—these great staples owe much to the pioneer efforts spent on them by the Institute. This pioneer work is unceasing, for new materials are constantly coming forward for investigation. Colonial food products, the raw materials of medical drugs, effective and reliable insecticides for the farmer, quick-drying vegetable oils or new mineral pigments for the paint manufacturer—these are a few out of many hundreds of products which the Institute has to examine and report upon, thus linking Empire supplies with Empire demands. This work has in many cases played an invaluable part in the war. Wild silk, for instance, and wild rubber are now of great and growing importance, and insecticides for safeguarding our vast food stores or for dealing with malarial mosquitoes are constantly being tested in the Institute's laboratories.

All the Governments of the Empire, with very few exceptions, help to finance the Imperial Institute for they appreciate its work ; and the Dominions, India and the Colonies are represented on its Governing Body together with United Kingdom Government Departments and representatives of science and commerce. Under the able directorship of Sir Harry Lindsay the staff of the Institute, though much curtailed by the war, continues, as always, to give unstinted and skilful service to what is at once one of the most idealistic and one of the most practical of our imperial conceptions.

THE IMPERIAL INSTITUTE

By SIR HARRY LINDSAY : INTERVIEW WITH MR. H. SWANZY

Recorded on December 28, 1942, for transmission in the Empire Programme of the B.B.C.

Cue : The Imperial Institute in South Kensington has just reopened its Public Galleries and its Cinema. If you go to a quiet part of London, past Hyde Park Corner and the Albert Hall, you come on a group of large buildings, built in the Victorian style. At first you might take them almost for churches or perhaps a university. And you'd be nearer the mark if you took them for the latter, because they are the great British museums and institutes set up during the nineteenth century : the Natural History Museum, the Victoria and Albert Museum, the Science Museum. One of these buildings is the Imperial Institute. It was built in memory of Queen Victoria's Golden Jubilee, and opened just about fifty years ago to act as a place where British people could learn about the Empire. At the beginning of the war its public Galleries were

closed. They have just been reopened, and we have here in the studio Sir Harry Lindsay, the Director of the Institute, to explain why.

HS : By the way, Sir Harry, can you say why the Institute closed down ? I mean, its public part closed down at the outbreak of war ?

HL : Well, you see, we were accustomed to quite large crowds visiting our Galleries, and 80 per cent. were schoolchildren. It was very difficult to provide proper shelters. But now, of course, there are plenty of public shelters quite handy.

HS : What interests the children most in the Galleries ?

HL : I think our biggest catch are the dioramas, lighted models of scenes in various Empire countries . . . sheep-farms, orchards and village huts, coastlines, harbours . . .

HS : Like the exhibition at Wembley ?

HL : Exactly. But perhaps I should explain about our Galleries. We have four, divided into "Empire Courts," and here we try to tell the story of each country in the Empire Overseas.

HS : And what do you yourself like best ?

HL : Well, we find what the schools like most—and that's what really interests us most—is seeing how each Dominion or Colony produces the raw materials of all sorts of everyday things in England.

HS : Things like tea and sugar ?

HL : Oh yes, but soaps, too, and candles and lipstick and, of course, cellulose—which makes everything from ping-pong balls to silk stockings. They see all these things in a West African palm tree or perhaps in Uganda cotton fields.

HS : Then you have other things as well, I believe ? I saw a mention of the Queen of Tonga's Royal Standard.

HL : Yes, indeed. That's our latest find.

HS : When did you get it ?

HL : Well, it was worked here with money presented by the islanders through Sir Harry Luke, the High Commissioner of the Western Pacific—Tonga is an island in the far south-west Pacific. We got a very charming letter from Her Majesty's Prime Minister with the standard, saying how pleased she was to present it.

HS : What is the standard like ?

HL : Actually I brought a photograph along. Let me see . . . here it is.

HS : Ah, yes. "The Standard of H.M. Salote—

HL : That's the Pacific version of Charlotte—

HS : —"H.M. Salote, D.B.E., Queen of Tonga." A dove with an olive branch, a crown, crossed swords, and three stars. All with a cross in the centre. What do the stars mean ?

HL : The Southern Cross, I think. But I may be wrong. The main thing is that the flag shows the history of Tonga which entered the Empire of its own free will.

HS : Well, the children will be able to learn all that now from the standard. But what about the other things before them ?

HL : There are so many. The great thing is to tell how people in the Colonies live. I wonder if you saw the exhibition we had just before the war of drawings by children in Uganda ?

HS : As a matter of fact I did. A friend of mine has a coloured print of one of them hanging in his room at the moment. It's of Jesus under the tree.

HL : That's interesting. There is a definite revival of interest in Colonial things in England. The other day I was seeing Meyerowitz, the Gold Coast man. He told me that the Cambridge educational authority has taken over the Art syllabus he uses in West Africa for its own schools.

HS : Aha. That particular authority is about the most advanced in the country.

HL : But lots more are coming into line. That's why the re-opening of the Institute will help in the good work. In fact, we anticipated it. We've organised a Colonial Empire Annexe, right in the centre of our Galleries. There's a large world map that lights up each Colony. It shows their resources, too. And alongside are batteries of moving pictures showing the life of the groups—the Mediterranean group, the East African, West African, West Indies, and so on. Also, an informograph—one of those push-button affairs !

HS : That too is very interesting. But I think there's only one more thing you need. A new canteen for all the children who will be coming.

HL : Yes, indeed. We haven't forgotten that !

LABORATORY DIALOGUES¹

A Broadcast on Investigation Work carried out at the Imperial Institute

Cue.—The jubilee of the Imperial Institute, one of the main central organisations for the investigation of Empire products, gives one an opportunity to illustrate both its work, and something of the processes by which a world empire is maintained.

NARRATOR : I went into the Imperial Institute, which is just 50 years old, and on the ground floor, I spoke to Sir Harry Lindsay,

¹ A recording of this broadcast, one of a series entitled "Experiment in Freedom," with Mr. H. V. L. Swanzy as Narrator, was transmitted in the B.B.C.'s Pacific and African programmes on June 6th and in the North American service on June 8th, 1943.

the Director, and had a glimpse of the fascinating public Galleries. But I had no time to wander around them. I took a lift and went up to the laboratories, high on the second floor. The scientific work of the Institute is divided into three sections : Mineral Resources, Plant and Animal Products, and Rubber. I went through these departments for the whole of one day. They are fairly empty now—the forty scientists who worked there in peace-time have sunk to a handful of key men. In the Minerals Lab. I met the Principal of the Mineral Resources Department, Mr. Sydney Johnstone. He told me what the assistants were doing at the moment.

JOHNSTONE : Well, you see those two large platinum dishes on that bench.

NARRATOR : Yes, what have they got in them ?

JOHNSTONE : A solution of caesium salts. One of our chemists is making an analysis of caesium ore from South West Africa sent in by the Union Government. We have already examined it microscopically and I know that it's going to turn out to be rather rich ; about 30 per cent. pure oxide, probably. Incidentally caesium ore is very rare—look, here is some of the mineral they sent us.

NARRATOR : And he showed me some small white fragments looking like marble chips. What is caesium used for ?

JOHNSTONE : It's used in photo-electric cells, caesium being a metal highly sensitive to light. These cells may be used in radio and television, but they also have uses more directly concerned with the war.

NARRATOR : My attention wandered to a large piece of crystal lying in a glass tank. The liquid had a familiar odour that I could not place. What's this for, Mr. Johnstone ?

JOHNSTONE : That is a piece of clear quartz, and it would be useful for the war too if only it weren't so full of flaws and cracks. We put it into that liquid which is synthetic oil of wintergreen (the stuff you use for rheumatism) because it enables you to see right into the crystal. You can see the flaws for yourself if I switch on this beam of light.

NARRATOR : Oh, yes, quite clearly ; but could you say what it is used for ?

JOHNSTONE : Big quartz crystals are most valuable in wireless for controlling wave-length and in anti-submarine detection as long as they are flawless. That particular piece there came from Southern Rhodesia, but this other one—it's much better quality —came from a geologist in Uganda. I only wish we could find more of it.

NARRATOR : And then I asked Mr. Johnstone if the examination of materials was his department's main work during the war.

JOHNSTONE : No, that was our peace-time job and mainly for the Colonies—the Dominions have their own organisations, of

course. Our main war work is to act as an expert inquiry bureau to Government departments, mainly the Ministry of Supply, the Ministry of Economic Warfare and Governments of the Overseas Empire. Inquiries come in almost every hour of the day.

NARRATOR: Could you say what sort of questions do come in?

JOHNSTONE: No. I can't very well do that; it's mostly confidential, but we get asked questions about almost every aspect of the mineral industry and about almost every country in the world—especially, of course, the British Empire. A particular favourite a little while ago was "What can we use in place of so-and-so that we used to get from such-and-such?"

NARRATOR: And so we talked. Mr. Johnstone told me of a request from a Cameroons district officer for advice on iron smelting. The tribesmen used to get their hoes from Germany, and they wanted to start making their own again and improve their old smelting methods. As we had come to West Africa, I asked Mr. Johnstone about tin.

JOHNSTONE: Naturally the Nigerian tinstone is very important now that we get no tin from Malaya, but the work is a bit hush-hush. I can tell you, however, that we have been able to tell them how to separate tinstone from another valuable mineral, columbite, by a new magnetic separator. Yes, we shall certainly be glad when we go back to our old job again; finding uses and markets for produce from the Colonies and advising technicians there.

NARRATOR: Before I go can you tell me if you give all this advice free?

JOHNSTONE: Yes, on the whole. Oh, by the way, some people seem to make a good deal of money occasionally from our work, but all the return we really like is to have news of the results of our advice and we don't always get that.

NARRATOR: And so I left Mr. Johnstone and went into the Plant and Animal Products Laboratories, where I found Dr. Furlong in the middle of an investigation with damaged goatskins which had arrived from West Africa. The work had taken three weeks already. I wandered through and saw a forest of chemical apparatus. What is this yellow liquid here?

FURLONG: It's pyrethrum concentrate—this dark one is stronger. We test their strength. You know about pyrethrum? It's a kind of daisy they grow in Kenya to use as an insect-killer, and now it's being used against malaria mosquitoes. They use it largely in world-famous insect sprays. Pyrethrum causes a high rate of "knock-down" amongst the insects. The kill is completed by a slower acting material like derris—that's a root from Malaya.

NARRATOR: In the middle of the laboratory was stacked a sea of fibres, like long, luxuriant horses' tails.

FURLONG : They are hard hemps and soft fibres. This one is sisal from East Africa ; we've shown it can be used in place of manila for ships' ropes. And these boxes beside them contain various flosses, which are of particular importance at the moment to replace Java kapok. These samples in the jars are for reference purposes. For example, we've been showing Ministry of Food Inspectors the type of goods they'll find in the big storage plants in this country. They inspect them for pests, but don't know what all Colonial commodities look like. By the way, those pyrethrum dopes are used to spray the store-houses !

NARRATOR : He went round between the benches and condensers, the extractors and burettes and bunsen burners, explaining processes as he went. Those twisted sticks ? Shellac ? I thought of shellac in connection with gramophone records. And isn't it a mineral ?

FURLONG : No, shellac isn't a mineral : it's made by insects on twigs, in India. This is bleached—much of it is.

NARRATOR : So we wandered round the laboratory, seeing the camphor oil from the Sudan—derived from *Ocimum kilimandscharicum*, if that means anything to you—and useful now that Japanese Formosa is cut off. I asked a final question. Are there any differences in your work here as compared with the last war ?

FURLONG : Yes ; we are more cut off from supplies by sea. Malaya made a very great difference, you know, especially in regard to rubber ; but you'd better ask Martin about that—he's our rubber man.

NARRATOR : So I went into the bowels of the earth with Mr. Martin, where I saw all the wild rubber they're getting now from Africa, and testing here in the Imperial Institute. You see, it's almost the only place in the world where they have information filed away about wild rubber from days before the Hevea tree became the king of rubber in Malaya. There the wild rubber lay : black, red, yellowish-brown, white. Rubber in balls, in sausages like meat, like anything on earth. I asked Mr. Martin where it all came from.

MARTIN : Some comes from bushes, some from trees—you see that ball like the inside of a golf-ball—that comes from a vine. Now, here's a twig : break it.

NARRATOR : I broke the twig, but it held together with hundreds of little glistening strands of rubber underneath the bark.

MARTIN : It takes Africans fourteen-and-a-half hours beating it to get a pound of rubber out of these twigs. We should like to find some simple machine to do the work for them. Wild rubber grows in hundreds of plants—even the English dandelion has 0·2 per cent. of rubber.

NARRATOR : Who sends this rubber to you ?

MARTIN : All African rubber is examined by us. You see, manufacturers want to know how far they can trust this wild rubber. It isn't quite as good as plantation rubber. It doesn't last as long. It breaks more easily. And so on. We test the wild rubber, make standards, and mix it with plantation rubber to make it stronger.

NARRATOR : How does wild rubber compare in strength with plantation rubber ?

MARTIN : You mean, the proportion of rubber in the resinous mixture that arrives here ? Well, Hevea is 92 per cent. pure rubber. We see that only rubber which has over 75 per cent. goes straight to manufacturers. Some wild rubber has much less than that. This evil-smelling product has only 15 per cent. rubber in it. It's the lowest collected in Africa and has special uses.

NARRATOR : How exactly do you test it ?

MARTIN : Well, look around. We've got a regular little rubber works here. Now, suppose I take this lump. First we pass it through this washing machine.

NARRATOR : He threw over a lever like a steam engine attached to a machine that looked like a mangle. The rubber came out in a thin strip. Sheets of this rubber were hanging on a line, next another mangle.

MARTIN : Wild rubber is sometimes very dirty. We've even found bits of torpedo in it. Next we put it through the masticator—that's the mangle to you. You see those pails behind ? They contain various metal oxides and sulphur. We mix the rubber with these on the mangle until it becomes thoroughly soft and hot. Then we roll it out thin and chop it into squares like a cook chops dough. Then, just like dough, we put the squares into aluminium trays and allow it to cook in the vulcanizer—that oven there. After all this process we have a finished piece of rubber. And we start to test it.

NARRATOR : As he was describing this the rubber went through all these processes. Mr. Martin then stamped the square of rubber into little rings.

MARTIN : Now we test these rings—that's the real test. We put it in this machine here and stretch. A graph reads the pressure on the ring and the distance it goes before it snaps. Then here's another test. Here are rings hanging on rails at a temperature of 70 degrees centigrade. As air is sucked into the container, they slowly oxidise—you'd say perish. Good rubber lasts a month under these conditions. Wild rubber not quite so long !

NARRATOR : I suppose all this has been new since Malaya ?

MARTIN : Naturally. The wild rubber is very useful, though you wouldn't think so looking at those bundles. The Africans in Nigeria call their latex Iku Hitler—"Death of Hitler." Quite right, too.

NARRATOR: Could you say what the total figures of rubber production are now?

MARTIN: Naturally I cannot give too many figures. But Africa, round about 1910, did produce 20,000 tons of wild rubber. Ceylon produced about 60 to 80 thousand tons of plantation rubber before 1939. That gives us a hundred thousand tons of rubber. Malaya and the Dutch East Indies produced nearly one million tons.

NARRATOR: Are we as short as that?

MARTIN: Pretty nearly. The Americans say the pinch will come round about next December, when they will have used up their reserves plus the wild rubber they get from South America. But they hope that synthetic rubber will be coming in on a large scale by then. And we work very closely with America.

NARRATOR: And so I left these scientists after a fascinating morning and afternoon. There they are, in the Imperial Institute, giving free advice to all who ask it—government offices or private firms—examining samples, keeping in touch with trade. The Imperial Institute helped to give the cocoa industry to West Africa, tobacco to Nyasaland, coffee to Kenya, coal to West Africa and tin to Nigeria. The Commonwealth may well be proud of the work this institute does, and of all the other agencies which have helped to develop industries around the globe.

PLANT AND ANIMAL PRODUCTS

NOTES

Tung Oil in the Empire.—In connection with the action taken by the Imperial Institute from 1917 onwards to develop the production of tung oil in Empire countries, referred to on page 32 of the Special Jubilee Number of this BULLETIN (Vol. XLI, No. 1, 1943), it should be recorded that, during 1928-1931, Dr. L. A. Jordan, Director of the Research Association of the British Paint, Colour and Varnish Manufacturers, obtained large supplies of tung fruits from Florida with the financial help of leading British varnish manufacturers, and distributed them for planting trials to Empire countries through the agency of the Royal Botanic Gardens, Kew.

In addition, the Research Association examined seed and oil resulting from these trials and did much to foster this development, as well as to carry out research work on the properties of tung oil.

The Imperial Institute is glad to publish this statement of a valuable enterprise.

Sugar-Cane Wax.—The following note amplifies and supplements that published in this BULLETIN, 1942, 40, II.

Sugar-cane wax occurs in a thin layer on the stalks of the cane. The amount varies with the variety of cane, but seldom exceeds 0.5 per cent. of its weight; more commonly it is less than 0.1 per cent.

It is possible to remove the wax from the stalks, before milling, by mechanical means, but the quantity is so small that in spite of various attempts no method has been found that would be practicable on an economic basis. It is therefore necessary to obtain the wax as a by-product of the processes involved in the manufacture of sugar.

When the canes are crushed, a part of the wax passes into the expressed juice, from which it is removed, with other matters, in the subsequent process of clarification, and so finds its way into the mud press-cake. This latter, when dried, may contain anything up to about 17 per cent. of crude wax, and it is by solvent extraction from this material that the sugar-cane wax of commerce is obtained.

The manufacture of sugar-cane wax was started in Natal in 1916. Some 250 tons of the wax were received in London in the two following years, and shipments were also made to the United States. In 1924 exports from South Africa totalled over 5,000 tons. However, the product failed to establish a footing in the face of

competition from a number of other waxes which made its manufacture uneconomic, and production was discontinued in 1930.

The present war has brought about a fresh interest in the subject, not only in South Africa, but more particularly in the United States, where the possibilities of recovering the wax in connection with the sugar industry of Louisiana are being investigated by the United States Department of Agriculture.

The Department has in view the possibility of producing some 3,000 tons of the wax annually, and the aim is to obtain a product superior to the original Natal wax, which had some objectionable features such as a sticky feeling, a dark colour difficult to bleach, and sometimes an unpleasant odour. Some of these undesired properties were due to the fatty matter which is present with the wax in the press-cake and has the effect of causing stickiness as well as of lowering the melting point of the product. The fat is to some extent destroyed if the press-cake is allowed to undergo putrefactive fermentation before extraction, and this procedure results in a harder wax. However, it appears likely that the disagreeable odour sometimes associated with the Natal product may have been due to this practice, and research is being directed to obtaining by other means a wax as free as possible from fat.

A pilot plant has been set up at the Sugar Plant Field Station, Houma, Louisiana, in order to study the question on a scale large enough to afford some idea of the costs of commercial production, and at the same time to provide a supply of the wax for manufacturing trials by prospective users.

An account of the problems to be investigated is given by R. T. Balch, of the Bureau of Agricultural Chemistry and Engineering, U.S. Department of Agriculture, in a "Preliminary Report on Sugarcane Wax" which appeared in the *Sugar Journal, Louisiana*, November 1941, Vol. 4, No. 6, pages 24-29, and it is mainly from this publication and from a later report on "Sugar Cane Wax Studies, 1941-42," by R. T. Balch and C. B. Broeg (*The Sugar Bulletin, Louisiana*, 1942, Vol. 20, No. 21, pages 189-191) that the following account has been compiled.

The principal problems investigated have been concerned with solvents and their use to the best advantage. The suggestion has been made that the solvent used should have a boiling point higher than the melting point of the wax. On this premise, available materials are limited to a few solvents of the naphtha type, some chlorinated compounds, and coal tar products such as benzol, toluol, and xylene. Chlorinated compounds are less hazardous but are more expensive, higher in density, and have the further disadvantage of giving rise to small quantities of hydrochloric acid, thus necessitating the use of acid-resistant plant.

At Houma practically no difference was found between toluol, benzol, and petroleum naphtha (boiling point 95°-103° C.) for extracting the crude wax from the dried press-cake, in spite of

some preliminary misgivings with naphtha owing to the lower solubility of the wax in it. Fears that difficulty might be experienced in removing the last traces of naphtha from the extracted wax also proved to be unfounded. The method of extraction adopted in the pilot plant is described as follows: "Dry mud press-cake is extracted with five charges of hot solvent; the first two extracts are combined and filtered, and the solvent recovered in a simple still; while the other three extracts are used in sequence for the extraction of the next charge of press-cake. As for the spent muds, these are subjected to steam distillation for the recovery of the solvent."

One point for investigation is the degree to which it is necessary to dry the press-cake, i.e. the proportion of moisture that can be left in it without impairing the efficiency of extraction. It does not appear that any findings on this question have as yet been published.

Other factors affecting efficiency of extraction are discussed in Balch's "Preliminary Report." Theoretically, the highest extraction in a given time might be expected from finely divided material, but this involves digestion, followed by filtration of the "slurry" or finely divided mud cake and wax solution, which may be an extremely difficult process. If on the other hand the cake is dried in a granular condition, extraction by percolation or diffusion is possible, and several extractions can be made with the same solvent on the counter-current principle. It is suggested that conceivably equipment as elaborate as a beet sugar diffusion battery might have advantages. This would make the process a continuous one, and experiments on such lines on pilot-plant scale are proposed.

After the crude wax has been separated, a further problem is the removal of the fatty matter which it contains, amounting to anything from 20 to 45 per cent. It has been found that this can be effected by a diffusion process in the cold, using a "selective solvent," acetone being indicated as having the greatest possibilities taking into account initial cost and other considerations. The process is a slow one, involving several changes of solvent and requiring several days for its completion. It is stated that as an alternative the counter-current principle can be employed, the crude wax being in the form of coarse chips. This gives a higher concentration of fat in the solvent and reduces recovery expenses. The only equipment needed consists of tanks which can be closed to prevent evaporation of the solvent and from which the fatty solution can be pumped to any one of the other tanks holding the crude wax or to the evaporator for the recovery of the solvent.

Reverting to the extraction of the crude wax from the press-cake, it is pointed out that the recovery of solvent both from the remaining cake and from the extracted wax is a "major step" in the process, as much of the cost of extraction may arise from loss of solvent. It is considered that it should be possible to keep the loss as low

as that in other solvent extraction processes, which is frequently as little as 0.5 per cent. per cycle.

Recovery of solvent from the spent cake can be effected by steam distillation. This, however, leaves the mud in a moist condition, and if this is not desired (it is suggested that there might be a sale for the extracted cake in dry form as a fertiliser) other methods, possibly involving the use of vacuum, may be found practicable. Recovery from the wax solution consists simply in distilling off the solvent. The last traces are eliminated by blowing the melted wax with steam or air. The same method applies to the recovery of the fat solvent used in removing the fatty fraction from the wax. After recovery the solvents can be used again at once, unless it is found desirable to dry them with a water absorbent such as calcium chloride.

It is to be observed that the proportion of crude wax in the press-cake varies over fairly wide limits. Thus in one series of press-cakes from 11 factories in Louisiana amounts ranging from 5.16 to 17.68 per cent. (on a moisture-free basis) were found, and in another series from 22 factories the proportion varied from 5.38 to 16.28 per cent.

This is no doubt in part due to the different varieties of cane concerned, but it is thought that other factors "not fully evaluated as yet" may be involved. These include: burning the cane as an aid to harvesting (which according to Natal experience may considerably reduce the wax content), extraction efficiency of the mills, temperature of the maceration water, types of pumps with which the raw juice and the muds are handled, clarification procedure (including equipment, temperature, and *pH* control) and the manner in which the muds are handled from the clarifiers through the presses. For the most economical recovery it is, of course, desirable that the percentage of wax in the cake should be as high as possible.

The crude wax varies in consistency from a relatively soft to a hard brittle product according to its source, the softer samples containing the higher proportions of fatty material. As extracted in the pilot plant it is generally dark green in colour and somewhat tacky. After removal of the fatty fraction the remaining refined wax is harder. The dark colour, which is only partly removed with the fatty matter, is stated to be due primarily to chlorophyll. The pigments remaining in the hard wax are very difficult to remove or bleach.

The fatty fraction has been found to contain, in addition to relatively low melting point fats, a component melting at about 132° C., which is probably a mixture of phytosterols. The opinion has been expressed that the fatty material separated from the crude wax would have a commercial value if available in sufficient quantities.

A fact to be noted is that in the milling of the cane only from one-third to one-half of the wax on its surface is dislodged and

becomes dispersed in the juice, so that more wax is lost with the bagasse than becomes recoverable from the press-cake. It does not appear that any means have been found for recovering the wax from the bagasse, but it is observed that "here is an opportunity for improving the over-all recovery of this by-product in the manufacture of sugar."

Two samples of refined sugar-cane wax, quoted in Balch's "Preliminary Report," had the following properties:

		(1)	(2)
Saponification value	.	27.20	53.3
Acid value	.	9.65	11.4
Iodine value (Hanus)	.	21.50	19.8
Melting point	.	78°-80° C.	79°-80° C.

The material should find many applications in industry, particularly if it were found possible to improve its colour, the best demand, among users of waxes in general, being for a light coloured product. In the United States sugar-cane wax is looked upon largely as a prospective useful addition to supplies of carnauba wax from Brazil.

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Safe Working Stresses for some Important Indian Timbers. By V. D. Limaye. *Indian For. Leaf.* No. 13 (*Utilis.*), *For. Res. Inst.* Pp. 11, 8 × 5½. (Dehra Dun, U.P.: Forest Research Institute, 1942.)

Selection and Field Testing of Aircraft Quality Spruce and Fir. By V. D. Limaye. *Indian For. Leaf.* No. 29, *For. Res. Inst.* Pp. 5, 8½ × 5½. (Dehra Dun, U.P.: Forest Research Institute, 1942.) Price As. 4.

Wood in the Plastics Industry. By A. J. Gibson. *Emp. For. J.*, 1942, 21, No. 2, 116-119.

Modern Methods of Wood Charcoal Manufacture. By P. J. A. Loseby and C. C. van der Merwe. *J. S. Afr. For. Assoc.*, 1942, No. 9, 31-43.

Note on Some Experiments on Cork Substitutes. By D. Narayananamurti, J. N. Pande and D. C. Roy. *Indian For. Leafl.* No. 6, *For. Res. Inst.* Pp. 4, 9½ × 5½. (Dehra Dun, U.P.: Forest Research Institute, 1941.)

Gums and Resins

Agar-agar Manufacture. By E. J. Ferguson Wood. *J. Coun. Sci. Industr. Res. Aust.*, 1942, 15, No. 4, 295-299. Summarised statement of the present position in Australia.

Annual Report of the Indian Lac Research Institute for the year 1941-1942. Pp. 26, 9½ × 7½. (Namkum, Ranchi, Bihar: Lac Research Institute, 1942.)

Preparing Varnish from Natural Gums. By A. G. Arend. *Paint Varn. Lacq. Manuf.*, 1943, 13, No. 1, 4-6.

Tanning Materials

Matières Tannantes d'Origine Végétale au Katanga. By L. Thuriaux. *Bull. Agric. Congo Belge, Léopoldville*, 1942, 38, No. 3 and 4, 245-254.

IMPERIAL INSTITUTE

CONSULTATIVE COMMITTEE ON INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

QUARTERLY BIBLIOGRAPHY ON INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

Prepared in collaboration with the Imperial Institute of Entomology and the Department of Insecticides and Fungicides, Rothamsted Experimental Station.

NO. 21 (October to December 1942)

GENERAL

Annual Report of the East Malling Research Station, near Maidstone, Kent, for 1941. P. 13, on the experimental farm derris was ineffective against the apple blossom weevil; nicotine successfully controlled the capsid bug on blackberries and on hops; p. 47, atomized pyrethrum spray reported to be successful against cherry fruit moth, but further work necessary before general recommendation can be made; p. 51, derris spray a useful means of preventing outbreaks of certain pests in experimental greenhouses; p. 58, strawberry aphid easily controlled on runners before planting by the use of a nicotine dip; p. 68, revised edition of the East Malling Spray Calendar.

The Production of Root Seeds. By W. Schultz. *Frmg. S. Afr.*, 1942, 17, 571-574. Spraying plants with tobacco extracts, nicotine sulphate or derris recommended for control of aphids; and pyrethrum dust or derris spray for dealing with the cabbage moth caterpillar.

Sprays to Kill Overwintering Codling Moth Larvæ. By M. A. Yothers, F. W. Carlson and C. C. Cassil. *J. Econ. Ent.*, 1942, 35, 450-451. (*Amer. Chem. Absts.*, 1942, 36, No. 20, 6295.) Sprays of either nicotine sulphate or pyrethrum extract effective.

Insecticidal Control of Legume Bugs in Seed Alfalfa. By R. A. Fisher and W. E. Shull. *J. Econ. Ent.*, 1942, 35, No. 4, 503. Mixture of pyrethrum and rotenone effective.

Laboratory Tests on the Toxicity of Insecticides to the Strawberry Weevil. By H. N. Pollard and W. A. Thomas. *J. Econ. Ent.*, 1942, 35, No. 4, 598. Nicotine, tobacco extract and pyrethrins tested.

Biology and Control of *Empoasca filamenta*. By H. C. Manis and E. L. Turner. *J. Econ. Ent.*, 1942, 35, 416-418. (*Amer. Chem. Absts.*, 1942, 36, No. 20, 6298.) Pyrethrum-cube-talc dust and pyrethrum extract lime-sulphur spray controlled this leaf-hopper on potatoes; cube-talc dust not effective.

Insecticides for Control of Cotton Insects. By R. C. Roark. *Chem. Engng. News*, 1942, 20, No. 18, 1169-1172. Use of rotenone and nicotine mentioned.

Cotton Jassids and Their Control. By K. B. Lal. *Indian Text. J.*, 1942, 52, 199. Killed by spraying with rosin compound, pyrethrum or other contact insecticide or by dusting with nicotine.

The Control of Cotton Insects. By F. F. Bondy and C. F. Rainwater. *Ann. Rep. S. Carolina Agric. Exp. Sta.*, 1940, 121-127. (*Amer. Chem. Absts.*, 1942, 36, No. 17, 5310.) Nicotine or rotenone mixed with calcium arsenate dust or rotenone with cryolite or barium fluosilicate gives good results.

Insecticide Tests for Cotton Aphid and Boll Weevil Control during 1941. By I. J. Beecnel and E. H. Floyd. *J. Econ. Ent.*, 1942, 35, No. 5, 623. Rotenone, nicotine and pyrethrins tested.

Insecticides to Control Bollworm, Boll Weevil, Cotton Aphid and Cotton Flea Hopper. By K. P. Ewing and R. W. Moreland. *J. Econ. Ent.*, 1942, 35, No. 5, 526. Arsenates with the addition of rotenone and nicotine tested.

Control of the Tobacco Thrips on Shade-grown Tobacco in Connecticut. By A. W. Morrill. *J. Econ. Ent.*, 1942, 35, No. 5, 646. Cube, pyrethrum and tobacco tested; pyrethrum superior in control.

The Control of Pill Bugs and Saw Bugs. By R. M. Bohart and A. Mallis. *J. Econ. Ent.*, 1942, 35, No. 5, 654. Nicotine, pyrethrum and derris tested.

Effects of Certain Larvicides on the Overwintering Larvæ of the Clear Lake Gnat. By C. C. Deonier and A. W. Lindquist. *J. Econ. Ent.*, 1942, 35, No. 5, 788. Derris and pyrethrum toxic.

Experiments on Combating Leaf-roller Moth in Plums. By O. Ahlberg. *St. Växtskyddsanst.*, *Växtskyddsnötiser*, 1939, No. 4-5, 73-75. (*Amer. Chem. Absts.*, 1942, 36, No. 18, 5602.) Spraying with quassia or with nicotine proved effective.

The Effect of Some Insecticides on the Immature Stages of the Potato and Tomato Psyllid (*Paratriozza cockerelli* Sulc.). By D. J. Pletsch. *J. Econ. Ent.*, 1942, 35, No. 1, 58-60. (*R. A. E.*, 1942, 30, A, Pt. II, 525.) Nicotine sulphate and pyrethrum were amongst the products tested.

The Artichoke Plume Moth and other Pests Injurious to the Globe Artichoke. By W. H. Lange. *Bull. No. 653, Calif. Agric. Exp. Sta.* Limited control of *Platyptilia carduidactyla* given by sprays of cube and nicotine; nicotine and cube sprays successful against aphids attacking artichokes.

Life History and Control of the Sugar-beet Webworm *Loxostege sticticalis* L. By J. H. Pepper and E. Hastings. *Bull. No. 389, Montana Agric. Exp. Sta.*, 1941. (*R. A. E.*, 1942, 30, A, Pt. 10, 463.) In laboratory tests there was no significant difference in dusts containing rotenone and other resins from cube root, or nicotine spray or pyrethrin sprays in controlling the pest.

Strawberry Root Weevils and Crickets as Household Pests. By E. I. McDaniel. *Ext. Bull. No. 230, Mich. St. Coll. Agric.*, 1941. (*R. A. E.*, 1942, 30, A, Pt. 11, 520.) Crickets (*Gryllus domesticus* L.) can be controlled with pyrethrum or rotenone dusts.

Pests of Tomatoes. *Agric. Gaz. N.S.W.*, 1942, **53**, Pt. 8, 374-379. Nicotine recommended for control of aphids and white flies; pyrethrum for the green vegetable bug and the Rutherglen bug.

The Grape or Vine Thrips, *Drepanothrips reuteri*, and its Control. By S. F. Bailey. *J. Econ. Ent.*, 1942, **35**, 382-386. (*Amer. Chem. Absts.*, 1942, **36**, No. 20, 6297.) Pyrethrum and nicotine sprays and dusts considerably reduce infestations.

The Relative Toxicity of Rotenone and Pyrethrum in Oil to the Argasid Tick, *Ornithodoros moubata* Murray. By G. G. Robinson. *Bull. Ento. Res.*, 1942, **33**, Pt. 4, 273.

Ueber Schadaufreten und Lebensweise der Graseule (*Charaeas graminis* L.) sowie Bemerkungen über Wurzeleule (*Parastichis monoglypha* Hufn.) und Lolcheule (*Epineuroma popularis* F.). By H. Maercks. *Z. PflKrankh.*, 1942, **52**, Pt. 2-4, 159-182. (*R. A. E.*, 1942, **30**, A, Pt. 11, 543.) Pyrethrum and derris tested in control experiments gave inconclusive results.

Versuche zur feldmässigen Bekämpfung des Rapsglanzkäfers mit Kontakt und Frassgiften. By W. Frey. *Arb. Physiol. Angew. Ent. Berl.*, 1941, **8**, 177-196. (*R. A. E.*, 1942, **30**, A, Pt. 11, 539.) In experiments on the field control of the rape beetle with contact and stomach poisons a proprietary derris dust containing 0.8 per cent rotenone gave the best results; a dust containing derris and pyrethrum gave inferior results.

Zur Kenntnis Wirkungsweise der Kontaktgifte mit besonderer Berücksichtigung der Permeabilität der InsektenCuticula. By J. Bredenkamp. *Z. Angew. Ent.*, 1942, **28**, Pt. 4, 519-549. (*R. A. E.*, 1942, **30**, A, Pt. 11, 512-513.) A contribution to the knowledge of the action of contact poisons with special reference to the permeability of the insect cuticle. Several vegetable insecticides were tested.

The Place of Concentrated Sprays in the Pea Aphid Control Programme. By H. Glasgow. *J. Econ. Ent.*, 1942, **35**, No. 5, 649.

Insecticides. By G. A. Freak. *Chem. and Ind., Lond.*, 1942, **61**, 429-431. Includes general information on pyrethrum, derris, cube, nicotine and anabasine.

Insecticidas de contacto e insecticáfugos. By J. de A. Guimaraes and L. Guimaraes. *Rev. Quím. Industr., Brazil*, 1942, **11**, No. 125, 18-21. Toxicity and mechanism of various contact insecticides, repellents and baits, including some of vegetable origin.

The Treatment of Scabies. By K. Mellanby, C. G. Johnson and W. C. Bartley. *Brit. Med. J.*, 1942, No. 4252, 1-4. (*R. A. E.*, 1942, **30**, B, Pt. 10, 145.) Experiments included tests with pyrethrum and rotenone.

Substitutes for Derris. *Mfg. Chem.*, 1942, **13**, 237. Brief note on work being carried out by Ministry of Agriculture on the possibility of substituting nicotine sulphate and lonchocarpus in dressings for warble fly in sheep.

The War Program and the Part which Insecticides and Disinfectants are Playing in it. By J. E. Dunn, P. A. Surgeon and L. Schwartz. *Soap*, 1942, **18**, No. 8, 91-94, 105. Pyrethrum and rotenone mentioned.

Penetration of Oils into Insect Eggs. (a) Influence of Oil Characteristics, (b) Influence of Age of Egg and of Species. Studies of Contact Insecticides. By R. L. Bickle. *Tech. Bull. No. 79, New Hampshire Agric. Exp. Sta.* Pp. 14, 9 x 6. (Durham, N.H.: Agricultural Experiment Station, 1942.)

ALKALOID-CONTAINING MATERIALS

Tobacco Products, including Nicotine and Nicotine Derivatives

Extracting Nicotine and Chlorophyll from Tobacco. U.S. Pat. 2,235,589. *Pharm. Absts. U.S.A.*, 1942, **31**, No. 5, 153.

Determination of Nicotine in Tobacco. Modification of the Official

Method. By K. E. Rapp, C. W. Woodmansee and J. S. McHargue. *J. Assoc. Off. Agric. Chem.*, 1942, 25, 760-763. (Abst. in *Analyst*, 1942, 67, No. 801, 395.)

The Alkaloids of Tobacco. By K. E. Jackson. *Chem. Rev.*, 1941, 29, 123-197. (*Pharm. Absts. U.S.A.*, 1942, 31, No. 10, 301.)

Determination of Nicotine in Fresh Tobacco. *J. Assoc. Off. Agric. Chem.*, 1940, 23, 804-810. (*Pharm. Absts. U.S.A.*, 1942, 31, No. 5, 153.)

The Tobacco Aphis—A Dangerous Pest. By C. W. B. Arnold. *Nyasaland Agric. Quart. J.*, 1942, 2, No. 4, 4-7. Use of nicotine spray or strong infusion of tobacco juice a "last hope" in control of this pest.

Some Observations on the Codling-moth Control Problem in Eastern New York. By O. H. Hammer. *Mass. Fruit Growers' Assoc., Rep. Ann. Meeting*, 1941, 47, 133-140. (*Amer. Chem. Absts.*, 1942, 36, No. 19, 5943.) Nicotine sprays reduced the number of wormy apples.

False Yellowhead Fireworm. By C. S. Beckwith. *Amer. Cranberry Growers' Assoc., Proc. Ann. Mtg.*, 1942, 72, 23-25. (*Exp. Sta. Rec.*, 1942, 87, No. 3, 401.) Spraying with arsenate of lead and nicotine sulphate added to Bordeaux mixture gave sufficient control of *Sparganothis sulfureana* to prevent browning of foliage but not enough to prevent a damaging second generation.

Field Studies of Codling-moth Larvæ Attractants. By W. Wingo and H. E. Brown. *J. Econ. Ent.*, 1942, 35, 284-285. (*Amer. Chem. Absts.*, 1942, 36, No. 19, 5943.) Effectiveness of nicotine-summer oil sprays increased by the addition of brown sugar to the spray.

Ueber Schäden durch *Orchestes fagi* L. und *Psylla costalis* Flor am Apfel. By W. Kotte. *Z. Pf. Krankh.*, 1942, 52, Pt. 2-4, 153-159. (*R. A. E.*, 1942, 30, A, Pt. II, 542.) Nicotine useful in control of these apple pests.

Efficiency of Nicotine Sprays for Codling Moth Control in the Pacific Northwest. By E. P. Dean et al. *J. Econ. Ent.*, 1942, 35, 387-392. (*Amer. Chem. Absts.*, 1942, 36, No. 20, 6294.)

The Influence of Storage on the Chemical Composition of Nicotine Sulphate and Copper Sulphate Drench. By M. C. Franklin and R. F. Powning. *Aust. Vet. J.*, 1942, 18, 72-75. (*Vet. Bull.*, 1942, 12, No. 12, 614); (*Amer. Chem. Absts.*, 1942, 36, No. 16, 4963.)

Compatibility of Copper Fungicides with Nicotine-Bentonite Insecticides. By J. E. Fahey. *J. Econ. Ent.*, 1942, 35, No. 4, 517.

Insecticidal Action of some Pyrrolines and Pyrrolidines on *Thermobia domestica*. By J. G. Kirchner and C. H. Richardson. *J. Econ. Ent.*, 1942, 35, No. 4, 525. Nicotine most toxic to the firebrat.

Notes on the Control of Cotton Aphids. By G. L. Smith, A. L. Scales and J. A. Fontenot. *J. Econ. Ent.*, 1942, 35, No. 4, 598. Nicotine and tobacco dusts tested.

Leafhoppers can Weaken Apple Trees and Reduce the Crop. By G. E. Marshall, N. F. Childers and H. W. Brody. *Proc. Ohio Hort. Soc.*, 1941, 74, 61-68. (*R. A. E.*, 1942, 30, A, Pt. II, 536.) Inclusion of nicotine in the spray schedule recommended for control.

El "melazo" (*Pseudococcus citri* Risso) en los parrales de Almeria. By A. R. Castro. *Bol. Pat. Veg. Ent. Agric.*, 1941, 10, 157-216. (*R. A. E.*, 1942, 30, A, Pt. 10, 478.) Nicotine spray recommended for control of this pest.

Free Nicotine and Cryolite Dust Mixtures. By E. H. Floyd, I. J. Becnel and C. O. Eddy. *J. Econ. Ent.*, 1942, 35, No. 5, 620.

Some Factors Influencing the Epidemiology of Apple Scab. By D. Powell and H. W. Anderson. *Trans. Illinois Hort. Soc.*, 1942, 75, 278-88. (*Amer. Chem. Absts.*, 1942, 36, No. 17, 5308.) Lead arsenate and nicotine sprays of little use in reducing scab infections.

Problems in the Industrial Utilization of Tobacco. By M. J. Copley, R. K. Eskew and J. J. Willaman. *Chem. Engng. News, News Ed.*, 1942, 20, No. 19, 1220-1222. Discusses the position with regard to the production of nicotine for insecticides.

Tobacco Diversion Program Boosts Insecticide Supplies. *Chem. Engng. News*, 1942, 20, No. 17, 1128. Diversion of low-grade tobacco to the manufacture of nicotine sulphate approved by U.S. Department of Agriculture.

Use of Waste Tobacco in Dips. By P. M. Bekker. (*Frng. S. Afr.*, 1942, 17, 695-698, 714). Addition of nicotine to arsenical dips found to be effective against the blue tick of cattle (*Boophilus decoloratus*).

Nicotine Products and their Importance as Insecticides. By B. Horowitz. *Aust. J. Sci.*, 1942, 4, 179-186. (*Amer. Chem. Absts.*, 1942, 36, No. 21, 6743.)

Nicotine Sulphate Output Subsidized [in U.S.A.] *Oil, Paint, Drug Rep.*, 1942, 142, No. 10, 3.

Insecticidal Composition. U.S. Patent No. 2,207,185, 1940. *Pharm. Absts. U.S.A.*, 1942, 8, No. 4, 109. Reaction product of nicotine or coniine and pectic acid.

Insecticidal Nicotine Compounds. U.S. Patent No. 2,232,662, 1941. *Pharm. Absts., U.S.A.*, 1942, 8, No. 4, 110.

Insecticide. U.S. Patent No. 2,207,694, 1940. *Pharm. Absts., U.S.A.*, 1942, 8, No. 4, 110. Nicotine or coniine or other volatile poisonous alkaloid with pectic acid.

Other Alkaloid-containing Materials

Combating Thrips on Flax. By M. V. Shmelves. *Len i Konoplya*, 1939, No. 12, 20-22. (*Amer. Chem. Absts.*, 1942, 36, No. 18, 5601.) Anabasine sulphate spray effective on mature flax.)

Insecticidal Properties of the Lupine Alkaloids. By S. I. Isaev. *Trudy Belorusskogo Sel'skokhoz Inst.*, 1939, 8, No. 30, 119-121. (*Amer. Chem. Absts.*, 1942, 36, No. 18, 5606.)

The Alkaloids of *Lycopodium* Species. I. *Lycopodium complanatum* L. By R. H. F. Manake and L. Marion. *Canad. J. Res.*, 1942, 20, No. 5, 87-92. Nicotine one of the eight alkaloids isolated; also isolated from *Equisetum arvense* L.

INSECTICIDE MATERIALS CONTAINING ROTENONE AND ALLIED SUBSTANCES

General

Twenty-Seventh Annual Report of the Experimental and Research Station, Nursery and Market Garden Industries' Development Society, Ltd., Turner's Hill, Cheshunt, Herts., for 1941. Pp. 58-59, gives account of experiments on wireworm control to protect lettuce plants, in which derris powder and lonchocarpus powder were among the products tested.

A Review of Methods for the Chemical Analysis of Rotenone-bearing Materials. By H. A. Jones. *U.S. Dep. Agric., Bur. Entomol. Plant Quarantine* E-563, 1942.

The Chemical Evaluation of Derris and Lonchocarpus Roots. By K. B. Edwards. *Industr. Chem.*, 1942, 18, 379-382. Discusses the difficulties associated with the evaluation of these roots.

Analytical Isolation of Rotenone from a Spray Solution. By F. A. Gunther. *J. Econ. Ent.*, 1942, 35, 458. (*Amer. Chem. Absts.*, 1942, 36, No. 20, 6300.)

Effect of Solvent on Rotenone in Solution. By E. P. Breakey. *Ann. Rep. West. Wash. Agric. Exp. Sta.*, 1939-40. (*Amer. Chem. Absts.*, 1942, 36, No. 17, 5312.)

Drug and Other Special Plant Possibilities of the Americas. By D. M. Crooks. *Oil, Paint, Drug Rep.*, 1942, 142, No. 10, 3, 62-63. Possibilities of derris, lonchocarpus and pyrethrum mentioned.

Constituents of Derris and Other Rotenone-bearing Plants. By H. L. Haller, L. D. Goodhue and H. A. Jones. *Chem. Rev.*, 1942, 30, 33-48. (*Pharm. Absts. U.S.A.*, 1942, 8, No. 9, 275.)

Corn Ear Worm on Lima Beans Controlled by Cryolite. By S. Marcovitch. *Ann. Rep. Tenn. Agric. Exp. Sta.*, 1940, 49-50. (*Amer. Chem. Absts.*, 1942, **36**, No. 17, 5311.) Rotenone of little value.

The Foot or Leg Louse of Sheep. By W. D. Shew. *J. Dep. Agric. Vict.*, 1942, **40**, Pt. 1, 15. Derris or rotenone dip recommended for control.

The Use of Derris and Cube Washes and Dusts in the Control of Cattle Grubs. By R. W. Wells and E. W. Laake. *U.S. Dep. Agric., Bur. Entomol. Plant Quarantine*, E-562, 1942.

The European Red Mite. By J. S. Houser and C. R. Cutright. *Proc. Ohio Hort. Soc.*, 1941, **74**, 26-34. Rotenone spray in summer is effective in control of this pest.

Rotenone in Combination with Calcium Arsenate for Cotton Aphid Control. By C. F. Rainwater. *J. Econ. Ent.*, 1942, **35**, No. 4, 500.

The Effect of Temperature and Wind on Pea Aphid Control with Rotenone-bearing Dusts. By R. L. Janes and H. F. Wilson. *Canner*, 1942, **94**, No. 11, 10-11. (*Exp. Sta. Rec.*, 1942, **87**, No. 3, 398-399.)

Control of Flea Beetles on Potatoes at New Church, Virginia, in 1941. By L. D. Anderson and H. G. Walker. *J. Econ. Ent.*, 1942, **35**, No. 5, 780. Substitution of calcium arsenate by rotenone-bearing materials in above district not desirable.

Caution urged in Use of Kerosene-rotenone Spray. By W. Ebeling. *Citrus Leaves*, 1942, **22**, No. 4, 1-2. (*Amer. Chem. Absts.*, 1942, **36**, No. 16, 4963.)

Kerosene-Rotenone Spray: Some of the Problems attending its Use as a Control for Red Scale. By W. Ebeling. *Calif. Citrog.*, 1942, **27**, No. 7, 188. (*Exp. Sta. Rec.*, 1942, **87**, No. 4, 549. Title only.)

Control of the Prickly Pear Cactus Thrips Rhopalo-thrips in Prune Orchards. By E. P. Breakey. *J. Econ. Ent.*, 1942, **35**, 460-461. Rotenone spray effective.

Bee Poisoning in Washington. By R. L. Webster. *J. Econ. Ent.*, 1942, **35**, 324-326. (*Amer. Chem. Absts.*, 1942, **36**, No. 20, 6299.) Cryolite-rotenone dusts not harmful to bees.

Report of the Alabama Agricultural Experiment Station, 1940, pp. 42-45. (*R. A. E.*, 1942, **30**, A, Pt. 10, 491-492.) Records results of laboratory tests carried out with derris, cube, timbo and *Tephrosia virginiana* against vegetable insects.

Rotenone Dispersion. A comparison Study of Two Powdered Aluminium Silicates used as Dispersing Agents for Rotenone. By H. F. Wilson and G. L. Bender. *Soap*, 1942, **18**, No. 10, 101-103.

Rotenone Imports to be Handled by the Commodity Credit Corporation [U.S.A.]. *Oil, Paint, Drug Rep.*, 1942, **142**, No. 19, 5.

Canada Restricts Rotenone. *Soap*, 1942, **18**, No. 10, 115.

Increased Toxicity with Rotenone Dusts. By E. J. Campau, H. F. Wilson and R. L. Janes. *Soap*, 1942, **18**, No. 8, 100-103.

Insecticidal Composition Containing Walnut-shell Flour. U.S. Pat. No. 2,283,275, 1942. Walnut shell flour incorporating rotenone for combating citrus mites, etc. *Amer. Chem. Absts.*, 1942, **36**, No. 20, 6301.

Stabilization of Insecticides. U.S. Pat. No. 2,279,800. Use of chemical compounds as stabilizers for insecticides derived from derris root, derris powder, timbo root, cube root or pyrethrum flowers. *Amer. Chem. Absts.*, 1942, **36**, No. 17, 5314.

Insecticides. U.S. Patent No. 2,242,911, 1941. *Pharm. Absts.*, U.S.A., 1942, **8**, No. 4, 110. Rotenone product.

Derris

Rotenone Determination in Derris Roots. By P. A. Rowaan and W. M. Sesseler. *Chem. Weekl.*, 1941, **38**, 744-745. (*Amer. Chem. Absts.*, 1942, **36**, No. 18, 5606.)

Carpenter Ant Control. By R. B. Friend. *Pests*, 1942, 10, No. 2, 12, 14. (*Soap*, 1942, 18, No. 8, 107.) Derris powder effective in killing this ant. Investigations on the Biology and Control of the Carrot Fly (*Psila rosae* F.). By F. R. Petherbridge, D. W. Wright and P. G. Davies. *Ann. Appl. Biol.*, 1942, 29, No. 4, 380-392. Derris powder gives control of this pest.

The Potato Moth (*Phthorimaea operculella*). *Agric. Gaz. N.S.W.*, 1942, 53, 327-329. Use of derris kaolin dust or derris spray recommended for control.

Grossbekämpfung des Rapsglanzkäfers (*Meligethes aeneus* F.) mit Derrisstaubemitteln in Ostholstein. By H. Goffart, W. Frey and W. Ext. Z. *PflKrankh.*, 1942, 52, Pt. 2-4, 113-131. (*R. A.E.*, 1942, 30, A, Pt. 11, 541-542.) Large-scale control of rape beetle with derris dusts in East Holstein.

Schädlinge an Hackfrüchten und Getreide in Beziehung zum Mehranbau. By K. Roos. *Mitt. Schweiz. Ent. Ges.*, 1941, 18, Pt. 7-8, 353-360. Derris dust proved effective against *Cassida nebulosa* attacking beet and mangels and also against *Athalia rosae* attacking turnips in Switzerland.

Lonchocarpus

Control of Flea Beetles on Cigar Wrapper Tobacco with Cube Dust in the Florida Georgia Area. By F. S. Chamberlin and A. H. Madden. *J. Econ. Ent.*, 1942, 35, No. 5, 634.

Others

Tephrosia Extract against House Flies. By H. A. Jones and W. N. Sullivan. *Soap*, 1942, 18, No. 9, 94-95.

Influence of Solvent, Method of Extraction and Carrier [Oil or Kerosene] on the Toxicity of Tephrosia Extracts. (In Russian.) By Z. K. Bogatova, *Proc. Lenin Acad. Agric. Sci., U.S.S.R.*, 1941, No. 9, 21-25.

PYRETHRIN-CONTAINING MATERIALS

Annual Report of the Department of Agriculture, Assam, for 1940-41. Cultivation of pyrethrum successful and arrangements being made for its extension, p. 11.

A Method of Physiological Assay of Pyrethrum Extracts. By O. Lowenstein. *Nature*, 1942, 150, No. 3817, 760-762.

Observations on the Chemical and Biological Testing of Pyrethrum Extracts and the Relative Toxicity of Pyrethrins I and II. By R. G. Green, W. Pohl, F. H. Tresadern and T. F. West. *J. Soc. Chem. Industr. Lond.*, 1942, 61, No. 11, 173-176.

Pyrethrin Determination. By V. S. Konovalov. *Khim. Referat. Zhur.*, 1940, No. 4, 61. (*Soap*, 1942, 18, No. 9, 115.).

Absorption Spectra and the Structure of Pyrethrins I and II. By A. E. Gillam and T. F. West. *J. Chem. Soc., Lond.*, 1942, Nov., 671-676.

Pyrethrum. By C. Smee. *Nyasla. Agric. Quart. J.*, 1942, 2, No. 4, 16-20. Includes particulars of the pyrethrin content of locally-grown pyrethrum flowers.

The Compound 4:6 Dinitro-o-cresol as a Cockroach Poison. By J. B. Gahan. *J. Econ. Ent.*, 1942, 35, No. 5, 669. More toxic than either sodium fluoride or pyrethrum.

Control of the Corn Earworm on Sweet Corn. By A. E. Michelbacher. *Bull. Dep. Agric. Calif.*, 30, No. 2, pp. 175-183. (*R. A.E.*, 1942, 30, A, Pt. 2, 555.) Oil containing pyrethrum injected into the "silk channel" proved effective.

Controlling the Rose Chafer. By R. Hutson. *Mich. Agric. Exp. Sta., Quart. Bull.* No. 24, 1942, p. 287-290. (*Amer. Chem. Absts.*, 1942, 36, No. 21, 6742.) Pyrethrum sprays and dusts offer the best control measures.

Lygus hesperus Knight and *Lygus elisus* Van Duzee in relation to Alfalfa Seed Production. By C. J. Sorenson. *Bull.* 284 of 1939 and *Bull.* 294 of 1940, *Utah Agric. Exp. Sta.* (*Amer. Chem. Absts.*, 1942, **36**, No. 17, 5309.) Pyrethrum dusts used, but not very successful.

The Beet Leafhopper and its Control on Beets grown for Seed in Arizona and New Mexico. By V. E. Romney. *U.S. Dep. Agric. Bur. Entomol. Plant Quarantine*, E-567, 1942. (*Amer. Chem. Absts.*, 1942, **36**, No. 18, 5600.) Pyrethrum effective under certain conditions.

Experiments to Combat Flea Beetles. By B. Tunblad. *St. Växtskyddsanst.*, *Växtskyddsnotiser*, 1939, No. 3, 50-52. A dusting of white arsenic and pyrethrum proved effective.

The Control of Rhododendron Bug with an atomized Pyrethrum Extract. By A. E. Borton. *J. R. Hort. Soc.*, 1942, **67**, 337-338.

Malaria Control by Spray-killing Adult Mosquitoes. Third Season's Result. By P. F. Russell and F. W. Knipe. *J. Malar. Inst. India*, 1941, **4**, No. 2, 181-197. (*R.A.E.*, 1942, **30**, B, Pt. 11, 168.) Effectiveness of kerosene and pyrethrum extract in the control of malaria in villages in Southern India was confirmed.

Commercial Control of the Pepper Weevil in California. By R. E. Campbell and J. C. Elmore. *J. Econ. Ent.*, 1942, **35**, 369-373. (*Amer. Chem. Absts.*, 1942, **36**, No. 20, 6298.) Pyrethrum dust gave little or no control.

Use of Pyrethrum against Ectoparasites of Domestic Animals. By V. I. Kurchatov. *Veterinariya, Moscow*, 1941, No. 2, 97-103. (*Vet. Bull.*, 1942, **12**, No. 12, 614.)

Pyrethrum Powder: a preliminary Note on its Use in the Control of Insect Vectors of Diseases. By C. B. Symes, J. McMahon and A. J. Haddow. *E. Afr. Med. J.*, 1942, **18**, No. 12, 360-376. (*R.A.E.*, 1942, **30**, B, Pt. 11, 175.)

Pyrethrum used to Treat Scabies and Pediculosis. By L. E. Napier and R. N. Chaudhuri. *Indian Med. Gaz.*, 1941, **76**, 333-335. (*Pharm. Absts.*, *U.S.A.*, 1942, **8**, No. 7, 211.)

The Toxicological Characters of Different Pyrethrum Varieties. By Mardjanian. *Proc. Lenin Acad. Agric. Sci., U.S.S.R.*, 1941, No. 10, 26-29. (In Russian.) Pyrethrin content and toxicological action of 16 varieties of Pyrethrum evaluated by different methods.

Breeding Pyrethrum for Insecticides. By B. M. Griner. *Proc. Lenin Acad. Agric. Sci., U.S.S.R.*, 1941, No. 6, 13-16. (In Russian.) An account of experimental selection work on pyrethrum done in the U.S.S.R.

Use of Pyrethrum Powder in Colloidal Solution as a Larvicide. By H. M. Jettmar. *Chinese Med. J.*, 1941, **59**, 565-569. (*Pharm. Absts.*, *U.S.A.*, 1942, **8**, No. 7, 205.)

Compounds Related to Sesamin: their Structures and their Synergistic Effect with Pyrethrum Insecticides. By H. L. Haller, F. B. LaForge and W. N. Sullivan. *J. Org. Chem.*, 1942, **7**, 185-188. (*Brit. Chem. Physiol. Absts.*, 1942, August, A., III, 636.)

Synergistic Action of Sesamin with Pyrethrum Insecticides. By H. L. Haller, E. R. McGovran, L. D. Goodhue and W. N. Sullivan. *J. Org. Chem.*, 1942, **7**, 183-184. (*Brit. Chem. Physiol. Absts.*, 1942, August, A., III, 636).

Histological Effects of Pyrethrum and an Activator on the Central Nervous System of the Housefly. By A. Hartzell and H. I. Scudder. *J. Econ. Ent.*, 1942, **35**, No. 3, 428.

Two Activators for Pyrethrins in Fly-Sprays. By E. R. McGovran and W. N. Sullivan. *J. Econ. Ent.*, 1942, **35**, No. 5, 792.

Some Notes on the Integument of Insects in Relation to the Entry of Contact Insecticides. By V. B. Wigglesworth. *Bull. Ento. Res.*, 1942, **33**, Pt. 3, 205-219. Has special reference to the effect of extracts of pyrethrum.

Insecticidal Principle in Smoke from Burning Insect (Pyrethrum) Powder. IV. By M. Nagase. *J. Agric. Chem. Soc., Japan*, 1941, **17**, 495-502. (*Amer. Chem. Absts.*, 1942, **36**, No. 21, 6743.)

Belgian Congo Pyrethrum. The Increasing Production of an Important Insecticide. By L. Tobback. *Anglo-Belg. Tr. J.*, 1942, 28, No. 13, 182-183.

More Kenyan Pyrethrum. *Chem. Tr. J.*, 1942, 111, 407. Pyrethrum Board called for a further increase of 20 per cent. in area under the crop.

Insecticidal Compositions. U.S. Patent No. 2,243,207. 1941. *Pharm. Absts.*, U.S.A., 1942, 8, No. 4, 110. Pyrethrum and o-cyclohexylphenol.

OTHER INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

Köderungsversuche mit Kleidermotten. By A. Hase. *Z. Angew. Ent.*, 1942, 28, Pt. 4, 550-570. (*R. A. E.*, 1942, 30, A, Pt. 11, 514.) In bait experiments with clothes moths the flowers of *Helichrysum arenarium* were tested: powdered flowers alone are not attractive to the moth.

Larvicide and Insecticide. *Pharm. Absts.*, U.S.A., 1942, 8, No. 4, 110. Cashew nut shell oil one of constituents.

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GENERAL

Tobacco-insect Investigations during 1941. By A. Morrill and D. S. Lacroix. *Bull. No. 457, Connecticut Agric. Exp. Sta.*, 1942, 260-266. (*Amer. Chem. Absts.*, 1942, 36, No. 22, 7217.) Pyrethrum gave better control of thrips than any other treatment; rotenone dust also successful.

Pests of Cucurbits. *Agric. Gaz. N.S.W.*, 1942, 53, Pt. 10, 462-466. Derris and pyrethrum useful in control.

Protecting Market Sweet Corn from the European Corn Borer. By W. A. Baker, D. D. Questel and C. H. Batchelder. *Leaf. No. 225, U.S. Dep. Agric.*, 1942. Derris or cube spray most satisfactory, but nicotine-bentonite found satisfactory in some cases; dual-fixed nicotine dust also effective.

Cabbage Aphis. *Adv. Leaf. No. 269, Minist. Agric. Lond.* Nicotine dust more effective in controlling aphis than derris dust; nicotine spray also recommended; certain pyrethrum insecticides effective.

Protection Against Insect Pests. *N.Z. J. Agric.*, 1942, 65, No. 5, 302-304. Nicotine sulphate spray or derris dust or spray recommended for the control of carrot pests and derris for white butterfly and diamond-backed moth on swedes.

Experimental Spraying for Control of Second-Brood Codling Moth. By L. A. Stearns. *Trans. Peninsula Hort. Soc.*, 1941, 40-45. (*R. A. E.*, 1942, 30, A, Pt. 12, 595.) Nicotine, rotenone and pyrethrum gave approximately the same degree of protection against the second generation of *Cydia pomonella*.

Cotton Insect Investigations in Peru. By F. F. Bibby. *J. Econ. Ent.*, 1942, 35, No. 2, 193-197. (*R. A. E.*, 1943, 31, A, Pt. 1, 10-11.) Rotenone, pyrethrum and nicotine sulphate tested.

The *Taxus* Mealybug (*Pseudococcus cuspidata* Rau.). *J. Econ. Ent.*, 1942, 35, No. 2, 173-175. (*R. A. E.*, 1943, 31, A, Pt. 1, 7.) Sprays of proprietary materials containing rotenone, rotenone and oil, or rotenone, pyrethrum and oil effective; nicotine sulphate spray even more effective.

The Blueberry Thrips. By F. H. Lathrop. *J. Econ. Ent.*, 1942, 35, No. 2, 198-201. (*R. A. E.*, 1943, 31, A, Pt. 1, 11.) Cube, derris and nicotine tested for control.

Effectiveness of Derris and Cube in Pickleworm Control. By F. S. Arant. *J. Econ. Ent.*, 1942, 35, No. 6, 870. Derris, timbo, cube and tephrosia tested against several insects.

Cube and Nicotine in the Control of *Phyllotreta vittata discedens* Weise. By M. J. Janes. *J. Econ. Ent.*, 1942, 35, No. 6, 939.

Die Kleine Fichtenblattwespe (*Lygæonematus pini* Retz.) ihre Prognose und die Aussichten für ihre Bekämpfung. By H. Gabler. *Tharandt. Forstl.*

Jb., 1940, 91, 646-686. Abstr. in *Z. PflKrankh.*, 1942, 52, Pt. 7-8, 420-421. (R.A.E., 1943, 31, A, Pt. 2, 76.) Weather decisive factor in success or otherwise of pyrethrum and derris to control the lesser spruce sawfly.

Frukttremidde og plommeveps. By T. H. Schøyen. *Norsk Hagetid*, 1940, No. 13. Abstr. in *Z. PflKrankh.*, 1942, 52, Pt. 7-8, 425. (R.A.E., 1943, 31, A, Pt. 2, 78.) 3 per cent. quassia spray effective against the fruit tree mite and the plum sawfly but 0.2 per cent. nicotine almost as effective.

Notes on the Control of the Fuller's Rose Weevil (*Pantomorus godmani* Crotch) on Kale. By H. G. Walker and L. D. Anderson. *Virginia J. Sci.*, 1940, 1, No. 7, 206. (R.A.E., 1942, 30, A, Pt. 12, 568.) Neither derris-talc dust nor pyrethrum-talc dust very effective in dealing with this pest.

Annual Report of the Department of Agriculture and Stock, Queensland, for 1941-42. Pp. 6-7 refers to the use of nicotine sulphate as an alternative to derris for control of grubs of the cabbage moth.

Control of Orange Tortrix. By A. M. Boyce. *Calif. Citrogr.*, 1942, 27, No. 8, p. 219. (R.A.E., 1943, 31, A, Pt. 2, 59.) Nicotine sulphate and pyrethrum extracts tested against coccids and mites.

Flea Control. By R. E. Roselle and L. Haseman. *Soap*, 1942, 18, No. 12, 123. Derris powder or pyrethrum or a combination of both recommended.

Zur Bekämpfung des Gartenlaubkäfers (*Phyllopertha horticola* L.). By W. Speyer. *NachrBl. Dtsch. PflSchDienst.*, 1941, 21, 72-73. (R.A.E., 1943, 31, A, Pt. 2, 52.) In laboratory tests pyrethrum did not give satisfactory control, but derris sprays were fully effective against *Anomalia horticola* L.

Bulletin of the Department of Agriculture, California, 1941, 30, No. 4. (R.A.E., 1942, 30, A, Pt. 12, 601.) Pp. 337-373, the twelve-spotted cucumber beetle controlled by dusts containing organic thiocyanate and pyrethrum; the pea aphid was not controlled by dusts containing rotenone or nicotine.

Insecticidal Compositions Suitable for General Use. U.S. Pat. No. 2,286,222. Pyrethrin or rotenone together with an organic thiocyanate and other chemical compounds. *Amer. Chem. Absts.*, 1942, 36, No. 22, 7224.

New Potential Insecticides. By R. C. Roark. *Soap*, 1943, 19, No. 1, 95-96.

ALKALOID-CONTAINING MATERIALS

Tobacco Products, including Nicotine and Nicotine Products

Preliminary Studies on the Cardamom Thrips (*Taniothrips cardamomi* Ramk.) and its Control. By M. C. Cherian and M. S. Kylasam. *Madras Agric. J.*, 1941, 29, No. 9, 355-359. (R.A.E., 1942, 30, A, Pt. 12, 611.) Tobacco extract spray only treatment which gave significant increase in percentage of capsules of good quality.

Preliminary Studies on the Control of the Gladiolus Thrips (*Taniothrips simplex*) in the Transvaal. By C. C. Hattingh. *Sci. Bull. No. 221, Dep. Agric. Un. S. Afr.*, 1940. (R.A.E., 1942, 30, A, Pt. 12, 611.) Nicotine sulphate the most effective of a number of insecticides tested.

Leopard Moth. *Adv. Leaf.* No. 259, *Minist. Agric. Lond.* Fumes of burning tobacco forced into the holes claimed to be effective.

Apple Sucker. *Adv. Leaf.* No. 96, *Minist. Agric. Lond.* Nicotine wash recommended for control of *Psylla malii*.

Toxicity of Nicotine Compounds to Newly Hatched Codling Moth Larvæ. By R. Hansberry. *J. Econ. Ent.*, 1942, 35, No. 6, 915.

Ertegallmyggen. By O. Husås. *Tidsskr. Norske Landbr.*, 1940, No. 3. Abstr. in *Z. PflKrankh.*, 1942, 52, Pt. 7-8, 427-428. (R.A.E., 1943, 31, A, Pt. 2, 79.) Spray of nicotine sulphate did not prove effective against the pea gall midge but useful if aphids also present.

Krusesyke på gulrot. By O. Husås. *Tidsskr. Norske Landbr.*, 1940, No. 1. Abstr. in *Z. PflKrankh.*, 1942, 52, Pt. 7-8, 428-429. (R.A.E., 1943, 31, A, Pt. 2, 78.) Nicotine sulphate sprays can be used for control of *Trioza viridula* causing crinkling of carrot.

Pæregallmyggen. By T. H. Schøyen. *Norsk Hagetid.*, 1940, No. 3, 2. Abstr. in *Z. Pf. Krankh.*, 1942, 52, Pt. 7-8, 426. (R.A.E., 1943, 31, A, Pt. 2, 78.) Nicotine sulphate spray effective against the pear gall midge.

The Lily Beetle (*Crioceris lilii* Scop.). By G. Fox-Wilson. *J. Roy. Hort. Soc.*, 1942, 67, Pt. 5, 165-168. Controlled by a nicotine dust.

Nicotine Treatment of Warble Fly. *Pharm. J.*, 1943, 150, No. 4138, 67. Method of preparation given. The formula replaces that used previously containing derris.

Versuche mit einigen Läusemitteln. By Heidegger. *Z. Veterinärk.*, 1942, 54, 160-166. (Vet. Bull., 1943, 13, No. 1, 32.) In trials with some delousing agents on horses nicotine and nicotine acetate were amongst the products tested; nicotine acetate was efficient.

Studies in the Biology and Ecology of *Retithrips syriacus* Mayet with special attention to its occurrence in Palestine. By E. Rivney. *Bull. Soc. Fouad Premier Entomol.*, 1939, 23, 150-182. (Amer. Chem. Absts., 1942, 36, No. 22, 7218.) Nicotine sulphate effective against these pests of *Myrtus communis*.

Problems in the Industrial Utilisation of Tobacco. By M. J. Copley, R. K. Esker and J. J. Willaman. *Chem. and Engng. News, News Ed.*, 1942, 20, 1220-1222. Investigations in United States on the wider utilisation of nicotine from surplus tobacco for use in insecticides and as a source of vitamins.

Nicotine Products and their Importance as Insecticides. By B. Horowitz. *Aust. J. Sci.*, 1942, 4, No. 6, 179-186. (R.A.E., 1943, 31, A, Pt. 1, 30.)

Formation of Nicotine in Plants Grafted on Tobacco. *C. R. Acad. Sci., U.R.S.S.*, 1941, 32, No. 5. (*Nature*, 1943, 151, No. 3829, 338.)

Nicotine. *Oil, Paint, Drug Rep.*, 1942, 142, No. 22, 65. Mentions use of nicotine as a conditioner for fertiliser mixtures.

Insecticidal Compositions. Brit. Pat. No. 544,897. Reaction product of nicotine with a ketone or aldehyde. *Amer. Chem. Absts.*, 1942, 36, No. 22, 7224.

INSECTICIDE MATERIALS CONTAINING ROTENONE AND ALLIED SUBSTANCES

General

Determination of Rotenone. Improvements in the Gravimetric Method. By S. I. Gertler. *Industr. Engng. Chem., Anal. Ed.*, 1942, 14, No. 11, 897-898.

Rotenone Determination. By P. A. Rowaan and W. M. Sesseler. *Chem. Weekblad*, 1941, 38, 744-745. (Abst. in *Soap*, 1942, 18, No. 11, 99.)

A Review of the Insecticidal Uses of Rotenone and Rotenoids from Derris, *Lonchocarpus* (Cube and Timbo), *Tephrosia* and Related Plants. Part I. By R. C. Roark. *U.S. Dep. Agric. Bur. Entomol.*, E-579, 1942.

Relative Effectiveness of Several Rotenone-containing Insecticides against Various Insects. By F. S. Arant. *J. Econ. Ent.*, 1942, 35, No. 6, 873. *Derris*, *timbo*, *cube* and *tephrosia* tested.

Rotenone-bearing Plants. By R. H. Moore. *Puerto Rico Agric. Exp. Sta. Ann. Rep.*, 1939, 71-93. (Abst. in *Soap*, 1942, 18, No. 11, 113.) References to toxicity of *lonchocarpus* and rotenone content of *tephrosia*.

Rotenone Substitute Now Under Study. *Oil, Paint, Drug Rep.*, 1942, 142, No. 21, 7, 62. Also reference in *Soap*, 1942, 18, No. 12, 135. Seed of *yam beans* a possible substitute; experiments being carried out in Cornell University.

Effect of the Addition of Sulfonated Oil on the Toxicity of Cube and Derris to Plant Bugs. By R. A. Fulton and N. F. Howard. *J. Econ. Ent.*, 1942, 35, No. 6, 867.

Die Bekämpfung der Dasselfliege. By R. Gotze. *Dtsch. Tierarztl. Wschr.*, 1941, **49**, No. 26, 316-318. (*R.A.E.*, 1943, **31**, B, Pt. 1, 15.) Rotenone effective in the control of warble fly.

U.S. To Buy Rotenone. *Soap*, 1942, **18**, No. 12, 137-138.

Derris

Derris Supplies from Brazil and Peru. *Chem. Tr. J.*, 1943, **112**, No. 2902, 12. Purchase and importation of derris products in U.S.A. to be in the hands of Commodity Credit Corporation.

Derris—New Control Order and Direction. *Public Ledger*, 1943, No. 33, 110, 1. *Chem. and Drugg.*, 1943, **139**, No. 3293, 298-299. Order extended to include any variety of *Lonchocarpus* whether as root or as powder.

Further Research with Chemical Agents for the Eradication of the Potato Beetle. By K. Sellke. *Arb. Physiol. Angew. Entomol.*, Berlin-Dahlem, 1940, **7**, 182-208, 257-268. (*Amer. Chem. Absts.*, 1942, **36**, No. 22, 7217.) Derris powders effective; derris sprays less so.

A Report on Some Investigations on the Corn Insects of Puerto Rico. By B. A. App. *J. Agric. Univ. Puerto Rico*, 1942, **25**, No. 4, 21-31. Derris ineffective against *Laphygma frugiperda* but effective in some cases against *Heliothis armigera*.

The Maize Stalk-Borer. *Frmg. S. Afr.*, 1942, **17**, No. 201, 763-766. Under intensive systems of farming, top-dressing with "derrisol" and cutting out of infested plants effective measures of control.

Beetle Borers in Stored Derris. *Agric. J. Fiji*, 1942, **13**, No. 3, 82. Measures for the prevention of infestation suggested.

A Preliminary Report of a Critical Examination of the Roots of *Derris elliptica*. By F. A. Gunther and F. M. Turrell. *J. Econ. Ent.*, 1942, **35**, No. 6, 941. An abridged summary of a histological and chemical study of roots of *D. elliptica*.

Ueber die Fuchsräude. By Schoop. *Dtsch. Tierarztl. Wschr.*, 1941, **49**, No. 40, 485-486. (*R.A.E.*, 1943, **31**, B, Pt. 1, 16.) Foxes infested with sarcoptic mites died of poisoning after immersion in 2 per cent. derris dip.

PYRETHRIN-CONTAINING MATERIALS

Pyrethrin Determination. The Determination of Pyrethrins in Mixtures of Pyrethrum Powder with other Insecticidal Ingredients and Various Diluents. By J. J. T. Graham. *Soap*, 1942, **18**, No. 11, 95-99.

Insecticide Specifications. Determination of Pyrethrin I Content. *Soap*, 1942, **18**, No. 12, 129, 147.

A Pyrethrum-Sesame Oil Aerosol used Against Cheese Skipper Adults. By S. C. Billings, L. D. Goodhue and W. N. Sullivan. *J. Econ. Ent.*, 1942, **35**, No. 2, 289-290. (*R.A.E.*, 1943, **31**, A, Pt. 1, 22.)

Insecticides for the Army. The Aerosol Insecticide Program and its Effects on the Insecticide Industry now and after the war. *Soap*, 1942, **18**, No. 11, 91-93. Gives an account of the aerosol bomb which contains a highly purified and concentrated pyrethrum extract plus sesame oil.

Army Louse Powder. *Soap*, 1942, **18**, No. 11, 105. Formula for product given—contains pyrethrins.

Control of *Ptinus* Beetles. By H. E. Gray. *Pests*, 1942, **10**, No. 7, 10-13. Pyrethrum and aliphatic thio-cyanates in refined oil useful in flour warehouses. (*Soap*, 1943, **19**, No. 1, 113.)

Versuche zur chemischen Bekämpfung von *Sitona lineata* L. By K. Thode. *Inaug. Diss.*, Bonn., 1941, Abstr. in *Z. Pfl. Krankh.*, 1942, **52**, Pt. 7-8, 416-417. (*R.A.E.*, 1943, **31**, A, Pt. 2, 75-76.) Good results in control by pyrethrum spray.

Mineral-oil Treatment of Sweet Corn for Earworm Control. By G. W.

Barber. *Circ. No. 657, U.S. Dep. Agric.*, 1942, p. 6. White oil to which pyrethrins have been added is an efficient contact insecticide.

Insect Pests of Stored Rice and Their Control. By A. I. Balzer. *Frms'. Bull. No. 1906, U.S. Dep. Agric.*, 1942, p. 22. Pyrethrum spray useful for destroying insects on walls, floors, ceilings, etc.

Pest Damage to Silk. By E. Hardy. *Silk and Rayon*, 1943, 17, No. 1, 38. Pyrethrum extract in highly refined white oil effective in combating warehouse insect pests which attack silk.

Chrysanthemum Capsid Control by Atomised Pyrethrum Extract. By F. O. Mosley. *J. R. Hort. Soc.*, 1943, 68, Pt. 1, 26.

Develop New Roach Powder. *Soap*, 1942, 18, No. 11, 113. A mixture of sodium fluoride and pyrethrum found to be more effective than either of these products alone.

Insect Pests. *Agric. Gaz. N.S.W.*, 1942, 53, Pt. 12, 559-563. Refers to the use of pyrethrum for the control of slaters and the Rutherglen bug.

Comparative Efficacy of Different Culicifuges under Laboratory Conditions. *Parasitology*, 1942, 34, No. 2, 152-154. (R.A.E., 1943, 31, B, Pt. 2, 35-36.) A number of preparations were tested, amongst which the most satisfactory was found to be a mixture of lemon-grass oil, pyrethrum extract in kerosene and coconut oil.

Studies on Corn Ear Worm Control. By L. P. Ditman, J. P. Secrest and E. N. Cory. *Bull. No. 439, Md. Agric. Exp. Sta.*, 1941. (R.A.E., 1942, 30, A, Pt. 12, 589.) Addition of 0.1 per cent pyrethrins to mineral oil increases its effectiveness in control of *Heliothis armigera* but not sufficiently to justify the cost of treatment; derris and nicotine did not increase the effectiveness of oil.

Memorandum on Measures for the Control of Mosquito Nuisances in Great Britain. By J. A. Sinton and P. G. Shute. *Publication of the Ministry of Health, Revised*, 1942. P. 18 recommends pyrethrum sprays for use in cellars, cattle-sheds, etc., and p. 23 as a larvicide.

Factors that may affect the Toxicity of Pyrethrum-oil Emulsions as Mosquito Larvicides. By W. W. Yates and H. H. Stage. *Proc. N. J. Mosq. Ext. Assoc.*, 1941, 28, 127-135. (R.A.E., 1942, 30, B, Pt. 12, 188.) Describes tests designed to ascertain the reason for the inconsistency sometimes shown in results obtained with emulsions of oil containing pyrethrum extract.

Comparative Resistance of Several Species of Mosquitoes to Larvicides. By H. H. Stage and W. W. Yates. *Proc. N. J. Mosq. Ext. Assoc.*, 1941, 28, 119-126. (R.A.E., 1942, 30, B, Pt. 12, 188.) Pyrethrum among the products used.

Experiments with three Types of Pyrethrum Oil Emulsions of the New Jersey Mosquito Larvicide. By J. M. Ginsburg. *Proc. N. J. Mosq. Ext. Assoc.*, 1941, 28, 159-162. (R.A.E., 1942, 30, B, Pt. 12, 190.)

Insecticidal Tests for Field Control of *Lygus* Bugs in Seed Alfalfa. By C. J. Sorenson. *J. Econ. Ent.*, 1942, 35, No. 6, 884. Pyrethrum dust (pyrocide) proved effective.

The Activating Effect of Pyrethrum upon the German Cockroach. By J. M. Hutzel. *J. Econ. Ent.*, 1942, 35, No. 6, 929.

Sesame in Insecticides. By C. Eagleson. *Soap*, 1942, 18, No. 12, 125-127. Discusses the effect of adding sesame to pyrethrum fly sprays.

Will a Pyrethrum Spray Kill Snakes? *Soap*, 1942, 18, No. 12, 100.

Pyrethrum Outlook [in U.S.A.]. *Soap*, 1942, 18, No. 12, 109-111.

What's Doing in All-India. North-West Frontier Province. By P. C. Raheja. *Indian Frmg.*, 1942, 3, No. 9, 503-504. Pyrethrum experimental work proving successful in certain districts.

Pyrethrum in Mysore. *Indian Frmg.*, 1942, 3, No. 8, 441-442.

Pyrethrum. Its Utility and Possibilities. By D. P. Majumdar. *Indian For.*, 1942, 68, No. 11, 598-604. Extract from *Allahabad Farmer*, 1942, 16, No. 2.

Pyrethrum Cultivation in Kenya. By R. S. Ball. *Nyasaland Agric. Quart. J.*, 1943, 3, No. 1, 11-22. Issued by the Kenya Farmers' Association (Co-operative), Limited.

Kenya Pyrethrum Output. *Public Ledger*, 1943, No. 33115, 1. Production aimed at in 1943 and 1944.

Pyrethrum. *For. Comm. Wkly.*, U.S.A., 1942, 9, No. 4, 36. Brief note on pyrethrum in Bulgaria.

U.S. Pyrethrum Imports. *Public Ledger*, 1943, No. 33,072, 1. Preference in allocation of shipping space in the U.S. has now been extended to pyrethrum flowers.

Stabilised Pyrethrum. U.S. Patent No. 2,300,612. *Soap*, 1943, 19, No. 1, 63.

MINERAL RESOURCES

ABSTRACTS AND NOTES

Geological Work in Nigeria.—The following report on the work carried out in Nigeria by his Department during 1942 has been received from the Acting Director of the Geological Survey of Nigeria.

The staff of the Department is still depleted owing to the war. Dr. R. C. Wilson, who has been director since 1927, developed a serious illness in October and will retire shortly.¹ During his tenure of office the Department has expanded its size and activities, inaugurating and carrying out extensive water-supply work in the provinces. He himself has been entirely responsible for establishing a museum which is of value to the departmental geologists and the mining community for reference and for educational purposes. He has also established a laboratory which enables the mining community and public in general to obtain quickly advice on specimens forwarded by them. In September the geological staff was augmented by the release of two men from military service.

Wolfram.—The chief geological work of the year has been the investigation of the wolfram resources of the country. Wolfram is associated with cassiterite and columbite-tantalite in the Plateau or Younger Granites of the Northern Provinces. Being easily disintegrated by abrasion it is not found with the large alluvial tin deposits, nor are there many lodes in the big granite masses of the Plateau itself, which have undergone extensive erosion by which the upper mineralised zones have been removed. The smaller masses to the north and south provide most of it.

Mapping of the tinfields was the main work of the Department in its earlier days and its Bulletins and maps have been the basis of the present investigations. However, the co-ordinates of many of the fixed points used have been altered on the modern sheets published by the Department of Lands and Surveys and this has involved revision in mapping. Concentration upon the peripheral regions of the Younger Granites has brought to light some inaccuracies in their outlines as depicted in the old maps, but it must be remembered that the early work was exploratory and a large area had to be covered in a comparatively short time. The following groups of hills had been examined by the close of the year : Tibchi and Yeli, Gamawa, Tongolo, Rishi and Neli, Dagga Allah, Zuku, Saiya and Shokobo, Jere and Sanga.

¹ While these notes were in the press, news of the untimely death of Dr. R. C. Wilson was received.

Wolfram occurs in quartz veins threading reefs of altered granite. This alteration is a replacement of the minerals of the original granite by topaz, green biotite and quartz, with sometimes fluorite or siderite. Tinstone, columbite and sulphide minerals may occur disseminated in the reef rock, but wolfram rarely does, preferring to crystallise only with quartz. It tends to be restricted to rich lenses of a few inches width, which in one reef may be many yards apart, but also occurs in long, persistent, though narrow quartz veins in which both quartz and wolfram crystals are arranged transversely to the direction of the vein. Alteration is not restricted to the Younger Granite, but affects the flanking Older Granites as well.

It is doubtful if under normal conditions many of these wolfram lodes could be profitably worked. To date most production has been from detrital (eluvial) deposits and open-cast working by the tribute system. The provision of adequate water has always been a difficulty as the outlying Younger Granite masses form isolated groups of hills which are local watersheds. Run-off is high and catchment areas small. The Wolfram Production Board, which came into being during the year and which controls production, is endeavouring to mine such lodes as its members think are of sufficient size and richness.

The Tibchi and Yeli Hills, of which Kalato and Kogo are the two chief wolfram producing camps, are riddled with reefs of altered granite, many of which are threaded by wolfram-bearing quartz veins or lenses. Some reefs cross from Younger to Older Granite without change in direction, indicating that the lines of weakness allowing penetration of the mineralising solutions did not develop until the Younger Granite was almost or completely solid. These reefs strike in all directions, but the most common is roughly north-west—south-east, which is the direction of the longer axis of the Younger Granite mass. It is considered that there is much more wolfram in these hills than in any other group.

In the Tongolo and Rishi and Neli Hills alteration of the Younger Granite occurs generally only in small patches and lumps and with one exception is accompanied only by tinstone and columbite. These patches, although seemingly unimportant, in the aggregate are the source of the considerable alluvial deposits of Pengel on the eastern side of the Tongolo Hills and Rishi and Wundi west of the Rishi Hills. Wolfram occurs almost entirely in veins within reefs of altered porphyritic Older Granites, within half a mile of the inter-granite boundary. These have been worked at Pakuru and Tabagindi in the northern part of the Tongolo Hills and at Jemaa Amadu west of the Rishi Hills. It is a matter of interest that a proportion of the cassiterite associated with columbite of the Younger Granite of the Rishi and Neli Hills is magnetic whereas that associated with wolfram in the Older Granite is entirely non-magnetic.

South of Dagga Allah Hill a wolfram-bearing lode in Older

Granite is unusual in that the gangue is milky quartz and there is practically no greisenization of the country rock. There is no cassiterite here either, which is also unusual. Mineralisation of the Younger Granite of the Dagga Allah group is very restricted in area and limited to cassiterite.

The remaining groups of hills show little promise of wolfram. Small veins occur in a patch of granite surrounded by the porphyries of the Saiya and Shokobo Hills but are of little value. The Jere and Sanga Hills appear to lack wolfram, but recently good alluvial columbite deposits have been discovered to the west of them near Jengre.

Limestones.—Guided by the work of the Imperial Institute upon limestones and shales from Igumale, the Public Works Department has taken up the matter of producing puzzolana cement. Assistance was given by the Geological Survey in selecting a quarry site for limestone.

Water Supply.—Sokoto City. No. 1 borehole of the Development Scheme was finished and water raised by air-lift. The compressor, unfortunately, was not new and was incapable of producing the full safe yield of the hole, which is at least 5,000 gallons per hour. Difficulty of obtaining rising main and air lift piping delayed the work considerably. In November a water supply for the Maiduguri Aerodrome was urgently called for and the drill was transferred there.

Well-sinking activities have been still further curtailed. Four wells were begun in Wukari town, Benue Province, and two were yielding by the end of the year. The underlying strata here are sandstones and shales of Cretaceous age. They are tough and although the sandstones seem porous they do not readily yield water. Elsewhere work was restricted largely to deepening or repairing old wells. There has been a succession of rather dry years in the north and in some parts the water table has dropped slightly. Sinking in Owerri and Calabar Provinces came to an end when the equipment was commandeered by the military authorities.

BOOK REVIEWS

Books for review should be addressed to "The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

THE PAINT LABORATORY NOTE Book. By John Stewart Remington. Second Edition. Pp. xi + 138, 8½ x 5½. (London: Leonard Hill, Limited, 1942.) Price 10s.

This little handbook, first published in 1935, has been extended to incorporate general tests for oils, and more complete notes on volumetric analysis. It now includes sections on simple tests for white and coloured pigments, oils and turpentine, and synthetic

resins, together with descriptions of some physical tests, and a selection of miscellaneous useful data.

The preface to the first edition expressed the hope that the book would be of use to paint manufacturers, especially the smaller firms who do not employ a qualified chemist. It is evident, therefore, that the scope of the book is not ambitious, and it appears most likely to be useful to those wishing to gain an insight into the elementary principles of paint testing. Some of the descriptions of methods may, however, be rather too sketchy to be easily followed by the unqualified persons for whom the book is intended, and it would be an improvement if such readers were encouraged to increase their knowledge by giving them more references to original sources of information.

There is evidently a demand for a book of this nature, and with careful revision and amplification there appears to be no reason why the limitations of the present volume should not be removed.

STANDARD METHODS FOR TESTING PETROLEUM AND ITS PRODUCTS.
Fourth Edition. Pp. xv + 390, $8\frac{1}{2} \times 5\frac{1}{2}$. (London : The Institute of Petroleum, 1942.) Price 15s.

In the new edition of this work the methods described in the previous edition have been thoroughly revised and an attempt has been made to include all those methods of testing required in official specifications, particularly those of the Services. A new system for designating the tests has also been adopted.

The number of methods now included does not differ very widely from that in the third edition, published in 1935, but the volume has nevertheless increased by 160 pages. The growth is due largely to the incorporation of descriptions of improvements in methods, all of which have been rewritten, and to more complete details of technique, etc. Some tests no longer in general use have been omitted.

Amongst the new methods described may be mentioned the determination of specific gravity by the Westphal balance (the omission of which from previous editions has been rather surprising), a rapid method of determining sulphur by combustion in a quartz tube, determination of flash point by the Cleveland apparatus, and the important oxidation test for lubricating oil, to the Ministry of Aircraft Production specification.

The imposing list of specialists included in the Chemical Standardisation Committee of the Institute of Petroleum, and in the Sub-Committees, all of whom have assisted in the preparation of the present volume, indicates that criticism is superfluous, and that the matter included must have been well considered. The book can be regarded as a standard treatise on the testing of petroleum and its products, and an essential part of the equipment of all who are engaged in such work. Henceforth it is proposed to issue fresh editions annually.

FUEL TESTING. By Godfrey W. Himus, Ph.D., A.R.C.S., D.I.C., M.I.Chem.E. Second Edition. Pp. xvi + 288, 9 $\frac{3}{4}$ x 6. (London : Leonard Hill, Limited, 1942.) Price 21s.

Accurate and speedy methods of testing any raw product are essential to its most effective commercial utilisation, and in view of the present necessity for fuel economy the revised edition of Dr. Himus's well-known book on Fuel Testing is issued at an opportune time.

The first edition was published in 1932 and contained 257 pages. Although in this new edition the introduction and the chapter on classification of coal have been omitted the book now contains 288 pages, which are larger than those in the earlier volume, so it is evident that much new matter has been added.

The subject matter, which deals with the testing of solid, gaseous and liquid fuels, has been considerably revised. In the chapter on calorific values, for example, only one type of bomb, the Griffin-Sutton, is now described, instead of the three others which were considered and illustrated before. Such a modification is to be commended, as the principle of operation in each case is the same. An additional chapter, on combustion calculations, is likely to be very useful to those for whom the book is intended. It may be remarked that the solid fuels considered are confined to coal and coke ; such fuels as wood, charcoal, peat, etc., are not discussed.

The greater, and the most valuable, part of the book deals with solid and gaseous fuel, the section on the testing of liquid fuels being brief. This section contains a short selection of methods of testing oil fuel abstracted from the third edition of Standard Methods for Testing Petroleum and Its Products, issued by the Institute of Petroleum. It is unfortunate that the book was published a short time too soon to permit of reference to the considerably revised fourth edition of the latter work, now available. It is doubtful, however, whether the duplication of effort involved in including descriptions of methods which are contained, with others, in a publication likely to be accessible to most users of the present work, is worth while, and the value of the book would not be diminished by the omission of this section from future editions.

The author's status as Senior Lecturer in Fuel Technology at the Imperial College of Science and Technology, and as former Chief Chemist to the Municipal Electricity Department, Shanghai, indicates that he has necessarily a wide knowledge of his subject, from both theoretical and practical aspects, and the book can be recommended as an authoritative treatise, invaluable to all interested in modern methods of fuel testing and conservation.

SOUTH AFRICAN SCENERY. A Textbook of Geomorphology. By L. C. King, Ph.D., D.Sc., F.G.S. Pp. xxiv + 340, 9 x 5 $\frac{1}{2}$. (Edinburgh and London : Oliver and Boyd, Ltd., 1942.) Price 25s.

This book deals very successfully with a subject which will appeal to most people interested in South Africa, both for its great

aesthetic attraction and the fundamental bearing it has on the economic and social development of the region. The first part of the book forms a textbook of physical geology, amply illustrated by photographs of South African landscapes, and it is a striking fact that Southern Africa can provide such good examples of most of the important geomorphological forms that, with the inclusion of a few photographs from New Zealand of glaciers, fjords, geysers and volcanoes, the 300 illustrations cover almost the whole field of the science. In the final 100 pages the different areas of Southern Africa as far north as and including Kenya, Uganda and the Belgian Congo, are discussed in some detail.

No good book on geomorphology could omit descriptions of such outstanding features as the rift valleys and lakes of East Africa, the Great Escarpment of Southern Africa or the inselberg topography of South West Africa, but here the author has the privilege of describing them in their complete setting. South Africa is a particularly suitable area in which to study the arid and semi-arid cycles of erosion, and these are well treated in this book. Other features, which few people normally associate with this region, such as the glaciers of Ruwenzori and the active volcanoes of the Belgian Congo, are also dealt with and add to the general interest of the subject.

Of the important economic aspects of geomorphology the author points out the dangers of soil erosion in semi-arid regions with intermittent torrential rainfall, a process so easily accentuated by human activities that its control is one of the most serious responsibilities facing the peoples of South and East Africa. The influence of land forms on other aspects of economic development is not stressed, but the reader will often recognise such effects for himself. The lack of navigable rivers has clearly been a hindrance to the development of Africa, but on the other hand the rapid construction of railways in South Africa at the end of the last century was greatly facilitated by the flatness of the Interior Plateau. The effects of climate and erosion on the discovery of mineral deposits on the ancient land surfaces are also worthy of mention. In South West Africa the clean rock surfaces developed in the arid climate have offered the most favourable conditions for the discovery of the small deposits of rare pegmatite minerals known in that region, while in contrast one may point to the thick cover of soil on the peneplains of Northern Rhodesia and the Katanga where rock exposures are so rare and mineralisation often obliterated by weathering.

South Africa certainly has scenery to be proud of, enriching the terminology of geomorphology with her dongas, vleis, poorts and kloofs, and fully deserving of the detailed scientific study which it has received in this admirable book.

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EXHIBITION GALLERIES, FILM LIBRARY AND CINEMA

NOTES

Exhibition Galleries.—After having been closed to the general public since the outbreak of war, the Exhibition Galleries and Cinema were, with the approval of the Board of Governors, re-opened to the Public every afternoon (Sundays and Bank Holidays excepted) with effect from December 14, 1942.

During the period of closure, as recorded from time to time in this BULLETIN, the attendance of organised parties and private individuals who applied for special permission to view the exhibits had continued to increase, and this fact, together with the return to London of a number of schools which had been evacuated to the country on the outbreak of war, emphasised the need for reopening the Galleries at the first favourable opportunity. Owing to the depletion of staff the reopening which has now taken place could not have been effected except for the voluntary help of members of the Women's Voluntary Services and the Forum Club, who between them have kindly provided a rota of ladies to act as custodians during the hours of opening.

Taking existing conditions into consideration the attendance of the general public since the reopening, especially during holiday periods, has been gratifying, whilst the visits from organised parties from schools and youth organisations (18 parties) ; Colonial and foreign evacuees (12 parties) ; United Kingdom, Dominion, Indian and Colonial troops (15 parties) ; Learned and Empire societies (11 parties), have been well maintained. In addition, four parties of entomologists recently appointed to the Infestation Branch of the Ministry of Food have made conducted tours of the Galleries to study samples of the raw products they are likely to meet with in bulk in warehouses, and Labour Officers recently appointed to various Colonies by the Colonial Office have visited the Courts of the countries to which they had been posted.

Amongst distinguished visitors and officials who have been received by the Director and conducted on a tour of the Galleries or a visit to a particular Court are the following :

On January 14, Col. Arter and Lt.-Commander R. E. Vining, Public Relations Officers with the United States Forces.

On January 29, Mr. G. B. Gresford, Australian Liaison Officer, Scientific and Technical Research.

On February 24, The Hon'ble. Col. Deneys Reitz, High Commissioner in London for the Union of South Africa.

On February 26, The Rt. Hon. Viscount Bennett, J.P., LL.B., K.C., formerly Prime Minister of the Dominion of Canada.

On March 4, Mr. R. O. Ramage, Colonial Secretary, Sierra Leone.

On March 12, Mr. J. Mockford, Public Relations Officer, South Africa House.

On April 11, Mr. C. E. S. Emmott, M.P.

On May 10, Nine members of the Australian and New Zealand Parliamentary Delegations accompanied by Mr. Spencer Hess, Assistant Secretary of the Empire Parliamentary Association.

New Exhibits.—Difficulty continues to be experienced in acquiring new material for exhibition either from manufacturers at home or from countries overseas, but new photographs have been obtained for use in various Courts as well as certain small exhibits that present no transport difficulties.

In the Indian Court have been arranged six series of photographs totalling 60 pictures illustrating "India To-day." These are arranged on pilasters in the East Gallery and illustrate (1) Modern irrigation and hydro-electric works ; (2) Educational Services ; (3) Medical Services ; (4) Social Welfare ; (5) Modern communications and transport ; and (6) Shipping and docks.

To bring the Indian Court into line with the other Courts in the Galleries a seat for the use of visitors has been constructed of Indian woods in the Imperial Institute workshop and installed in the Court. The woods employed are teak (*Tectona grandis*), Indian mahogany (*Cedrela toona*), Indian walnut (*Aleurites moluccana*), sissu (*Dalbergia latifolia*), poon-spar (*Calophyllum tomentosum*) and Indian coral or mochi wood (*Erythrina indica*).

Through the courtesy of H.E.H. the Nizam's Government, photographs of castor, linseed, safflower and groundnut cultivation, together with three of graphite mining and marble quarrying, have been received from the Department of Commerce and Industry, Hyderabad. Some of these photographs have been utilised for making coloured transparencies which are now displayed above the Hyderabad show cases. The new transparencies show the harvesting of castor seed, linseed and safflower seed, the lifting and decorticating of groundnuts, maize in the Aurangabad market, and notable buildings and scenery.

To the Burma Court has been added a collection of gem concentrates from the Ruby Mines at Mogok, kindly presented by Mrs. Kathleen Bacon, widow of the late manager of the Mogok Ruby Mines, Ltd. The concentrates, which consist mainly of spinels, are exhibited in association with the other Burma gemstones. Six Burmese figures, colourful representations of "Thagya Min," King of Nats and his consort ; a Burmese man ; a Shan man and two women pedlars ; presented to the Imperial Institute by the

executors of the late Miss M. B. Hunter, M.B.E., have been added to the exhibits in "The Romance of Burma" show-case.

The British Somaliland Court has been improved by the display, on two wall screens, of a series of enlargements showing typical views and types of people in the Colony and Protectorate.

Through the kind co-operation of Miss A. Nicol Smith, of the Zanzibar Museum, photographs illustrating local life and handicrafts have been acquired for the Zanzibar Court; also a collection of specimens of local handicrafts. Some of these objects were presented by the Zanzibar Museum, others are the personal gifts of Miss Nicol Smith.

To the Southern Rhodesia Court have been added a specimen of cinnabar ore and a small collection of tungsten ores from various areas in Southern Rhodesia. These were received for exhibition from the office of the Geological Survey, Salisbury, through the Secretary for Mines. To this Court has also been added a series of enlarged photographs of public buildings recently erected in various centres in the country. These photographs, prepared from negatives originally supplied by the Director of Public Works, Salisbury, and kindly loaned for our use by the High Commissioner for Southern Rhodesia in London, illustrate the style of architecture adopted for modern official buildings and schools in Southern Rhodesia.

Through the generosity of Dr. T. A. M. Nash, Medical Entomologist of the Sleeping Sickness Service in Nigeria, who kindly placed his negatives at our disposal, a series of enlargements has been prepared to illustrate new phases of Social Welfare work in Nigeria.

In the South African Court, the manganese exhibit has been augmented by the addition of a photograph of the liner *Queen Mary* in dry-dock showing her four massive manganese bronze propellers, and by a model in manganese-bronze, one-twelfth actual size, of a propeller designed for a British warship. Both items were kindly supplied by Messrs. J. Stone & Co., Ltd., of Deptford, who are well-known specialists in manganese-bronze casting.

In the Canadian Court, the former highly technical but rather dull flow-sheet exhibit illustrating the pulp and paper industry has been replaced by a modern story exhibit which deals with the industry on more popular and more attractive lines. It is entitled "From Forest to Reader—a story of Canadian Wood Pulp and Paper."

In the British Guiana Court, a statuette of Sir Walter Raleigh has now been installed. It is the work of Mr. Herbert H. Cawood, A.R.B.S., who is responsible for several other statuettes in our collection of Empire Builders. A photograph of this latest addition appears opposite, and the descriptive label attached to the pedestal reads as follows :

"Sir Walter Raleigh

1552—1618

Explorer and Pioneer of Colonisation

PLATE IX.



SIR WALTER RALEIGH.

A Statuette in the British Guiana Court of the Exhibition Galleries
of the Imperial Institute.

" Born in 1552 of Devonshire yeoman stock, Raleigh at the age of 17 took part in the struggle of the French Huguenots. He returned to England after the terrible massacre of Saint Bartholomew, and for a time studied law, but in 1578 he was once more prompted by the spirit of adventure, and joined his half-brother, Sir Humphrey Gilbert, in the latter's first expedition to the Americas. After the failure of this expedition, Raleigh sought fortune at Court, where he attached himself to the entourage of the Queen's favourite, the Earl of Leicester. Through him Raleigh obtained a captaincy in the foot guards, and in 1580 saw service in Munster. In 1581 he returned with despatches for Queen Elizabeth, who, attracted by Raleigh's handsome figure, charm and ready wit, singled him out for special favour and reward. During this period of favour, which included the famous 'cloak' episode, Raleigh obtained a charter of exploration and colonisation, and in 1585 he sent out his first expedition which founded the settlement of Virginia, so named in honour of the Virgin Queen. For this service Raleigh received a knighthood. Other parties of settlers were sent out to Virginia in 1586 and 1587, but the leader of the latter party on his return reported the ruin of the settlement and the disappearance of the settlers. As a result of this serious blow to his fortune and reputation, Raleigh went into retirement, solacing himself with tobacco, the smoking of which had been taught him by Ralph Lane, his first Governor of Virginia.

" In 1595 he emerged from retirement to plunge into a new venture, the search for the fabulous El Dorado of South America. On the resultant voyage Raleigh visited the island of Trinidad (where he discovered the Pitch Lake) and also the coast of Guiana (where he explored the Orinoco), but he discovered no El Dorado, and on returning to England, he joined Sir Francis Drake and was present with him at the attack on Cadiz in 1596. For his share in this exploit, Raleigh was accorded a measure of his old popularity at Court, but on the death of Queen Elizabeth in 1603 he became embroiled in the conspiracies which marked the early months of the reign of James I, and for this he was arrested, tried and sentenced to death. This sentence, however, was commuted to imprisonment in the Tower, where, during his 13 years' detention, Raleigh wrote many literary treatises, as well as poems, and his 'History of the World.'

" In 1616, Raleigh was granted freedom on his promise to produce for King James a gold mine in Guiana. The resultant expedition was a disastrous failure, and on its return in 1618 Raleigh was promptly rearrested and executed under his old death sentence."

Also in the British Guiana Court, a display showing "What the diamond digger finds in his sieve" has been added to the diamond display. It demonstrates how the heavy concentrate obtained from the preliminary washing of the diamond-bearing gravel is

manipulated in a hand-sieve to segregate the minerals and bring the diamonds to the centre, whence they are easily recovered. Around the sieve are grouped specimens of the various minerals which make up the concentrate, and among them the series of the diamond digger's "indicators" are of especial interest. This new exhibit was supplied by the Department of Mines, Georgetown, through the kind offices of Mr. S. Bracewell, and has been augmented by the loan of specimens of British Guiana diamonds by Messrs. E. A. P. and A. Triefus, diamond merchants of British Guiana and London.

In the Falkland Islands Court has been installed an illuminated stereoscope which enables the visitor to view a series of vivid cameos of life and scenery in both the Colony and its Dependencies. This stereoscope, with many of the views which it contains, was presented by Lady Allardyce, widow of the late Sir William Allardyce, K.C.M.G., a former Governor of the Colony. Also in this Court is now displayed a coloured pictorial map which shows the world position of the Falkland Islands and their Dependencies, their coat of arms, their sheep ranches, and other interesting details.

To the exhibits in the British North Borneo Court has been added a collection of modern pottery, mainly stoves and cooking utensils, as made and used by the Malayan settlers. This collection was formed by Major-General Sir Neill Malcolm, K.C.B., D.S.O., who generously donated it to the Institute for display in the Borneo Court.

In keeping with the other Courts of the Exhibition Galleries, the Royal Standard of H.M. Salote Tubou, D.B.E., Queen of Tonga, in damask silk appliquéd, the work of the Royal School of Needle-work, has now been hung over the Tonga exhibit in the Western Pacific Court. This beautiful and colourful work of art was presented for exhibition in the Court, by the Government of Tonga, at the suggestion of Sir Harry Luke, K.C.M.G., then Governor and Commander-in-Chief of Fiji and High Commissioner for the Western Pacific.

To the Papua and New Guinea Court has been added a plume of bird of paradise feathers from New Guinea, bequeathed with some ethnological exhibits by the late Miss M. Hunter, M.B.E., who for many years resided in New Guinea. Plumes such as this were formerly imported for use in ladies' head-dresses and hats until the passing of the Importation of Plumage (Prohibition) Act, 1921, stopped the trade.

A collection of shields bearing in heraldic colouring the arms and badges of the various Colonies has been received after use in the Government Pavilion at the New York World's Fair. These shields are now displayed in their respective Courts throughout the Galleries.

Empire Lantern Slide Library.—The last report printed in this BULLETIN, 1942, 40, 253, covered the period February to July 1942.

Since then, up to the end of March 1943, the circulation of lantern slides to schools and other educational institutions has totalled nearly 50,000. The details for each month are shown below :

	Aug.	Sept.	1942.	Oct.	Nov.	Dec.	Jan.	1943.	Feb.	March
United Kingdom .	180	180	180	60	120	420	300	420		
Australia . .	120	360	300	300	60	600	720	480		
Canada . .	120	180	1,260	780	420	1,200	960	420		
New Zealand . .	60	60	120	120	240	300	360	480		
South Africa . .	120	—	180	240	—	120	600	420		
India . . .	350	1,380	1,020	1,140	720	1,080	1,200	1,260		
Burma . .	—	420	240	240	300	300	240	360		
The Colonial Empire	240	1,740	2,340	3,300	2,340	3,360	3,180	3,960		
Products of the Colonial Empire .	—	—	300	420	300	60	60	60		
General Tours . .	—	60	240	300	240	300	300	240		
History . .	—	60	240	720	180	180	360	300		
	<u>1,190</u>	<u>4,440</u>	<u>6,420</u>	<u>7,620</u>	<u>4,920</u>	<u>7,920</u>	<u>8,280</u>	<u>8,400</u>		

Of the five new Picture Talks printed during this period, four were written by Mr. R. D. Anstead, C.I.E., and are concerned with India. In " Irrigation " Mr. Anstead first refers to the importance of the water supply in a country comprising nearly 400 million people, 90 per cent. of whom are tillers of the soil. From ancient times the Indian people have endeavoured to conserve and direct the rainfall in order to increase the productivity of the land. This particular talk surveys the various methods of lifting and distributing water commonly in use in India, and goes on to describe the canals, dykes, and dams which modern engineering skill has made possible and which together with improved transport facilities have done so much towards the conquest of famine in India.

" Sugar-Cane and Cotton." Although India is the home of the sugar-cane and the largest producer in the world the canes are often thin and give low yields when compared with the varieties grown in other tropical countries. Reference to the work of the Agricultural Department in improving strains is followed by a description of the planting, cultivating, cutting and crushing of the canes and the preparation of gur and refined white sugar. The section on cotton follows the same lines and tells of the research work and propaganda carried out to supplant the ordinary short-stapled Indian varieties by improved strains of long-stapled cotton.

" Plantation Crops " deals with the cultivation of Tea, Coffee, Rubber and Coconuts, their location in India, the conditions on the plantations and the preparation of the crops for export.

" Forestry and Forest Life " is concerned with the story of the transition from improvident and ruthless destruction of forests to meet immediate needs to a policy of ordered exploitation which results in a continuous supply of timber and fuel, gums, resins, dyes and tanning materials. The influence of the forests in forming rain belts and water catchments and preventing soil erosion is

explained, and the elephant, tigers, buffaloes, boars, cheetahs and other wild animals are described and illustrated.

The new Picture Talk on Malta was written by Mr. J. Sultana of the Malta Government Education Department. First comes a short description of the strategical importance of the island and the resulting chequered history up to the time when the Maltese invited Great Britain to assume responsibility for its government and defence. The advantages accruing to both the Maltese and Great Britain as a result of the development of the naval base is stressed. A series of pictures shows the fleet in the Grand Harbour and the architectural treasures built during the long association with the Knights of St. John. The difficulties of persuading crops to grow and animals to flourish on a rocky island which has only a very thin top soil are described and followed by scenes from the everyday life of the Maltese people.

Central Film Library.—Since September 1942 a large number of new prints has been added to the Library, including an addition of over 500 new prints to the Empire and United Kingdom sections. Of these 500 new prints 200 are copies of 19 titles new to the Library, and the remaining 300 are either additional copies of films already in circulation or replacements of subjects which had been withdrawn (because prints had become worn out) but were considered worth replacing. Among the new titles are films on Canada, Australia, New Zealand, South Africa, Cyprus and Kenya, as well as a number of new films about the United Kingdom. The new United Kingdom films include a silent film on Northern Ireland and four sound films about Scotland. The 16 mm. South African section which had become very depleted owing to prints becoming worn out and difficulty of replacement has now been considerably strengthened. During the same period more than 70 new titles have been added to the Ministry of Information section of the Library including new films about Canada, Australia and India. In November 1942 new catalogues were issued for the Library as follows: (1) Catalogue of Empire films, (2) Catalogue of United Kingdom films including G.P.O. films, (3) Catalogue of Ministry of Information films. There are now some 800 different films in the three sections of the Library and of these films there are some 14,000 prints available for loan to borrowers.

The school season runs from September to August, and the detailed statistics of film circulation have been maintained on this basis. During the season 1941-42 despatches of Empire films exceeded 34,000, of which nearly 24,000 were made during the eight months September 1941 to April 1942. During the eight months September 1942 to April 1943 the total had risen to nearly 26,000, of which nearly 16,000 were 16 mm. silent films and over 9,000 were 16 mm. sound films, the rest being 35 mm. sound and silent. The demand for silent 16 mm. films is very striking.

but it does not convey an altogether accurate picture for the Library is able to meet demands for 16 mm. sound films, but is very hard pressed to satisfy demands for 16 mm. silent films. Indeed, during the two months preceding the Christmas holidays of last year the Library had to refuse all bookings for 16 mm. silent films before January ; and the same thing happened prior to the Easter holidays this year. Our great difficulty is to secure sufficient numbers of good 16 mm. silent films of the Overseas Empire ; and our grateful thanks are due to the Imperial Relations Trust which by its grants has enabled us to improve greatly on the present shortage so far as Dominion and all-Empire films are concerned. Grants have also been received from the High Commissioner for India and from the Colonial Empire Marketing Board which have enabled us to improve our stock of silent films of Indian and Colonial subjects.

Empire Lectures to Schools.—In a recent letter to *The Times* a correspondent wrote : “ Like many of my generation, I grew up in lamentable ignorance of the Empire, and I do not wish my children to do the same.” To the Director and staff of the Imperial Institute it is a matter for no little satisfaction that so much of their work is devoted to providing the means of teaching the rising generation about the British Empire by every possible aid to education : by exhibits, both interesting and instructive ; by publications ; by cinematograph films ; by lantern slides and film strips, postcards and posters and by the spoken word.

Whilst facts are impressed on the minds of children by visual aids to education presented in an attractive form it is no less true to say that one of the most successful ways of creating interest is by the spoken word. The professional lecturer has, in some cases, a number of advantages over the amateur ; but for the child there is nothing to take the place of the lecturer, whether amateur or professional, who has actually lived in the country about which he speaks and who can answer questions from his or her own personal experiences. Lecturers under the Imperial Institute Lecture Scheme are all men and women who have lived for some years in the Empire overseas and many are citizens of one or other of the Dominions, India or the Colonies.

The success of the Institute’s Lecture Scheme cannot be determined by statistics alone, although these provide a yardstick by which progress is measured. The interest which these lectures create in the minds of children, on whose shoulders the responsibility of Empire will eventually rest, can best be seen in their eager faces as they are grouped around a Canadian, an Australian, an Indian or a Nigerian who is telling them about his own people, their home and outdoor life, or about the responsibilities and ideals of the Commonwealth.

During the twelve months ended August 31, 1942, the number of lectures given to schools reached 768, and the audiences aggregated

over 126,000. During the eight months ended April 30, 1943, the number of lectures reached a total of 939, and the aggregate audiences nearly 159,000. In fact, it is becoming apparent from the number of letters of appreciation from Head Teachers which are continually being received and from repeated requests for lecturers, that Empire education, through the medium of the Imperial Institute Lecture Scheme, is finding an increasingly useful and important place in the school curriculum. The popularity of the Scheme is immediate when schools realise that lecturers awaken a personal interest in the Empire which no text-book, however well and profusely illustrated, can evoke.

It has been found by experience that the best results are obtained when schools are able to set aside a period, after the more formal lecture, expressly for the purpose of giving the senior pupils an opportunity to discuss more advanced topics, such as political development, social problems and imperial problems, and this widening of the scope of the Scheme has, in recent months, met with no little success. During the period under review the Imperial Institute has sent its lecturers out in the capacity of leaders of discussion groups organised by, and consisting entirely of, school teachers. From reports received of these meetings it would seem that the experiment has been amply justified.

In a number of cases Directors of Education lend their invaluable aid in the detailed arrangements necessary for the organisation of lecture tours. Such co-operation is greatly appreciated, and with this help and within the limits which shortage of staff and funds impose, the Scheme is slowly but surely and effectively developing on these lines.

It is encouraging to note that parts of the country which, hitherto, had not participated in the Scheme are now beginning to show keen interest. Statistics of audiences during the last eight months, in comparison with the twelve months ending August 1942, are as follows :

	12 months 1941/2.	8 months ending 30th April, 1943.
Northern Counties	41,000	41,755
Western Counties	10,000	5,790
Midland Counties	39,000	28,652
Southern Counties	36,000	80,561
Eastern Counties	Nil	2,132
 Total	 136,000	 158,890

Until a few months ago the Scheme was confined to schools not within easy reach of the Imperial Institute—Schools which had not had the advantage of frequent visits to our Exhibition Galleries. The increase in the interest shown by schools of the Southern Counties is probably due to the removal of this limiting factor.

Out of the 768 lectures given last year nearly half were given to the accompaniment of slides ; a few to films and a few more to

the accompaniment of both films and slides. This year the number of lectures with slides has increased and is now approximately two-thirds of the total number given to date (939). There is still a demand for lectures accompanied by films or by films and slides.

It is, of course, open to the school itself to select the subject for each lecture given so long as the subject is of Empire interest. Last year 100 lectures were given on Canada; 108 on Australia; 23 on New Zealand; and 68 on South Africa. India claimed 135 lectures, the British Colonies 232, and General Empire subjects 102. This year Australia has gone ahead with 132 lectures; Canada 83; South Africa 69, New Zealand 36, and India 106. General Empire subjects accounted for 98 lectures, but the most popular of all seem to be those related to one or other of the Colonies or else to the Colonial Empire as a whole—415 lectures, not far short of half of the total of 939 given during the eight months ending April 30, 1943.

Colonial Visitors.—The following is a list of officers on leave from the Colonial Empire who have visited the Institute during the period January-May 1943:

JANUARY

L. H. BROWN, Agricultural Officer, Nigeria.
 G. S. CANSDALE, Assistant Conservator of Forests, Gold Coast.
 R. G. MORGAN, Assistant Conservator of Forests, Gold Coast.
 R. PATTERSON, Inspector of Mines, Nigeria.

FEBRUARY

T. HIRST, Senior Geologist, Geological Survey, Gold Coast.

MARCH

K. W. BLACKBURNE, O.B.E., Colonial Secretary, The Gambia.
 R. O. RAMAGE, C.M.G., Colonial Secretary, Sierra Leone.

APRIL

P. C. HODGSON, Assistant District Officer, Nigeria.

MAY

E. A. CADLE, Education Officer, Nigeria.
 W. J. DAVIES, Principal, Prince of Wales School, Sierra Leone.
 P. PAYNE, Agricultural Officer, Nigeria.
 H. R. PHILLIPS, Senior Education Officer, Nigeria.
 W. S. DE G. RANKIN, Education Officer, Nigeria.
 T. W. DAVIES, Colonial Secretary, Leeward Islands.

All Dominion and Colonial Officers, as well as private residents overseas, who may be visiting London, are cordially invited to come to the Institute to see the Exhibition Galleries and to discuss scientific and technical problems in which they may be interested.

BULLETIN OF THE IMPERIAL INSTITUTE

VOL. XLI. NO. 3.

JULY-SEPTEMBER, 1943

PLANT AND ANIMAL PRODUCTS

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

*Selected from the Reports made to the Dominion, Indian and
Colonial Governments*

PEAT WAX FROM CHATHAM ISLANDS, NEW ZEALAND

AN important commercial wax of mineral origin is that known as montan wax. This is extracted from lignite, and is used for a wide variety of purposes as a substitute for the more expensive carnauba wax and beeswax, especially in shoe polishes and creams. A similar wax is obtainable from peat, and some years ago a supply of peat from Chatham Islands was sent to the Imperial Institute in order to determine the nature and properties of the wax that could be extracted from it. As will be seen from the report on the investigation, published in this BULLETIN, 1927, 25, 243-250, the results were very promising, and it was recommended that small-scale commercial trials in the preparation of the wax should be undertaken. No further developments seem to have taken place at that time, but in view of the shortage of waxes in certain areas caused by war conditions, the matter has been taken up again by the New Zealand authorities, and a sample of wax prepared from Chatham Islands peat in the Dominion Laboratory was forwarded to the Imperial Institute for examination in April 1942. The report on this investigation which was furnished to the New Zealand Government in July 1943 is printed below. As mentioned later, the work has been carried out in collaboration with Mr. Leo Ivanovszky, who has written a separate report, to be published in *Petroleum*.

The peat wax sent from New Zealand was stated to have been "extracted by wax-works benzol" and to represent "about 10 per cent. of the air-dried weight of the peat."

The sample weighed 9 oz., and consisted of a block, 4 in. \times 4

in. \times $1\frac{1}{2}$ in., of a very dark brown, brittle wax. The wax was translucent in very thin layers. The fracture took on a good polish when rubbed. On grinding, the sample smelt strongly of benzene.

Results of Examination.—A scheme of chemical examination of the peat wax was arranged in collaboration with Mr. Leo Ivanovszky, a well-known authority on waxes, who has been consulted throughout the investigation. The results are shown below in comparison with the usual range of figures for montan wax, which peat wax resembles in many respects and for which it is suggested as a substitute.

		Present sample of Peat Wax.	Montan Wax*
Loss at 100° C.	per cent.	3.2	—
A. Matter insoluble in boiling alcohol		42.4	—
(by difference)	"	42.4	—
consisting of:			
(ar) Matter insoluble in petrol		21.8	ca. 10.0
(b.p. 80-100° C.)	"	21.8	ca. 10.0
(a2) Matter soluble in petrol		20.6	—
(b.p. 80-100° C.)	"	20.6	—
B. Matter soluble in boiling alcohol		54.4	—
consisting of:			
(br) Matter soluble in boiling		37.1	—
but insoluble in cold alcohol	"	37.1	—
(b2) Matter soluble in both		17.3	—
boiling and cold alcohol	"	17.3	—
X. Matter soluble in petrol		74.0	—
(b.p. 80-100° C.)	"	74.0	—
Y. Matter insoluble in benzene		0.3	less than 0.5
Z. Matter soluble in cold ether		21.9	15-20
Ash	"	0.4	less than 0.5
Acid value	"	33.3	20-40
Saponification value	"	129.8	50-90
Melting point ° C. (open tube method)		69	ca. 80
Specific gravity at 18° C.		1.033	ca. 1.0

* The somewhat wide range for some of these figures is due to the fact that the composition of montan wax varies according to differences in the extraction procedure, in the water content of the lignite extracted, in the solvents used, in the size of the coal, in the pressure and temperature during the extraction, and to the bitumen content of the coal.

Miscibility with Paraffin Wax.—Mixtures of peat wax with paraffin wax (m.p. $54-60^{\circ}$ C.) were made in the following proportions:

- (a) 1 part peat wax and 1 part paraffin wax,
- (b) 2 parts peat wax and 3 parts paraffin wax,
- (c) 1 part peat wax and 5 parts paraffin wax.

In (a) and (b) homogeneous mixtures were obtained and no separation of the constituents took place. In (c) the peat wax did not mix completely with the paraffin wax, but a portion of it rapidly separated out on the cessation of stirring. Miscibility of peat wax and paraffin wax depends on the ratio of peat wax to paraffin wax and decreases rapidly with the increasing paraffin wax content of the mixture.

Descriptions and Examination of the Fractions

Fraction A. Insoluble in boiling alcohol.—Very dark brown, brittle substance softening below 100° C. M.P. 255° C. (closed tube method). Reddish-brown and translucent in very thin layers. The high melting point of this fraction—which may not really be a melting point in the strict sense of the words—is due to the composition of the fraction, which consists of approximately equal proportions of “asphaltic matter” (fraction a1) and matter soluble in petrol (fraction a2).

Fraction (a1). Portion of Fraction A insoluble in petrol (b.p. 80-100° C.).—Very dark brown and brittle. M.P. not below 360° C. There is no evidence that the fraction melts at a higher temperature. When mixed with an equal weight of paraffin wax the latter was absorbed by the former, but the mixture did not melt. Ash content 2.3 per cent.

Fraction (a2). Portion of Fraction A soluble in petrol (b.p. 80-100° C.).—Reddish-brown, hard substance of waxy nature. It softened at 74° C., and melted at 83° C. (open tube method).

Fraction (b1). Soluble in boiling alcohol but insoluble in cold.—Reddish-brown, hard substance of waxy nature, similar in appearance to (a2) but not quite so dark in colour. After saponification and removal of the unsaponifiable matter by petroleum ether, the acids were isolated. These acids were reddish-brown in colour and melted at 71-72° C. (open tube method). Their neutralisation value was 133.9.

Fraction (b2). Soluble in boiling and cold alcohol.—Reddish-brown, hard substance not so brittle as fraction (b1). It did not give a positive reaction in the Storch-Liebermann (Moravsky) test for rosin. On trying to recrystallise this fraction from alcohol an amorphous dark reddish-brown substance was obtained (m.p. 60° C.—closed tube method).

Fraction x. Portion of original wax soluble in petrol (b.p. 80-100° C.). Very dark reddish-brown and brittle. M.P. 71° C. (open tube method).

Fraction z. Portion of original wax soluble in cold ether.—Dark reddish-brown and brittle. M.P. 63° C. (open tube method).

The four fractions (a1), (a2), (b1) and (b2) were submitted to examination with the following results :

	(a1).	(a2).	(b1).	(b2).
Melting point (open tube method), °C.	360	83	71.5	54
Acid value	6.1	26.3	51.4	65.9
Saponification value	151.8	107.6	114.8	128.6

It will be seen from the above results of examination that the peat wax can be readily separated into four fractions, namely :

(a1) A fraction (21.8 per cent.) of an "asphaltic" nature¹ not melting below 360° C.

(a2) A fraction (20.6 per cent.) of a waxy character, insoluble in hot alcohol but soluble in petrol.

(b1) A fraction (37.1 per cent.) of a waxy character, soluble in hot but insoluble in cold alcohol.

(b2) A fraction (17.3 per cent.) of a resinous nature, soluble in both hot and cold alcohol.

Fraction X is a mixture of fractions (a2), (b1) and (b2). Fraction Z (soluble in cold ether) is apparently similar to (b2).

Comparison with the previous Sample.—The wax prepared from a sample of Chatham Islands peat received at the Imperial Institute in 1926 (see p.) was extracted with benzene, as was the case for the present sample of peat wax. The previous sample of peat wax (i.e. prepared at the Institute) gave the following results on examination, and these are shown below in comparison with those obtained for the present sample :

		Previous Sample.	Present Sample.
Melting point °C.	:	70-74	69
Acid value	:	55	33.3
Saponification value	:	120	128.9

The previous sample of wax was similar in appearance to the present one, but it was of a rather redder shade. The analytical figures for the earlier sample are of the same order as those of the later sample.

Comparison with Montan Wax.—The following comments on the composition of the peat wax and on its commercial value as a substitute for montan wax are based on a report furnished to the Imperial Institute by Mr. Leo Ivanovszky, to whom a sample of the wax was submitted.

The peat wax resembles fairly closely the usual grade of montan wax extracted from German lignites by means of volatile organic solvents. In practical respects peat waxes, in particular New Zealand peat wax, differs from montan waxes mainly in the two following ways. Peat waxes have as a rule lower melting points and a lower compatibility with paraffin wax than a good grade of montan wax. The reasons for these differences are due to the composition of the peat waxes which is slightly different from that of montan wax. The latter wax contains on an average about 20 per cent. of resinous constituents and about 10 per cent. of "asphaltic" matter, whereas the present sample of peat wax contains about an equal amount of resinous matter but about twice as much "asphaltic" constituents.

The four fractions, (a1), (a2), (b1) and (b2), prepared from the present sample of peat wax are similar to fractions prepared in the

¹ The term "asphaltic" is applied to this fraction as the latter resembles asphalt in appearance and physical properties; the fraction however differs from asphalt in having a saponification value.

same way from montan wax although there may be some differences which impart slightly different properties to the original waxes.

Like montan wax peat wax has a conchoidal fracture, which is however slightly more glassy than that of montan wax and somewhat shiny. It is harder but less brittle and rather tougher than montan wax. In contrast to montan wax, melted peat wax does not form a thin and mobile liquid, but rather a heavy liquid and thread-spinning mass. Peat wax has neither a sharp melting point nor a sharp setting point. Melted peat wax and melted paraffin wax can only be mixed with difficulty and by no means completely. Montan wax, on the other hand, mixes with paraffin wax in all proportions without difficulty.

The constants of peat wax resemble fairly closely those of montan wax except that the melting point is, as a rule, about 10° C. lower and the specific gravity slightly higher than the corresponding figures for montan wax.

Another difference between peat wax and montan wax is in their respective behaviour when the surface of blocks of these waxes are melted. The surface of melted peat wax on cooling assumes an enamel-like appearance, whereas montan wax resumes its original dull appearance.

The presence of a high content of "asphaltic" matter and to some extent the resinous fraction are responsible for the less favourable properties of the peat wax. It can be assumed that perhaps a slightly different method of production of the peat wax would remove these disadvantages. It may not be necessary to remove the total amount of these two constituents to produce a product that more closely resembles montan wax, which itself contains quite a considerable proportion of these two bodies. It is most probable that a reduction of these two fractions in the peat wax by an altered method of production would lead to satisfactory results.

In order to be in a position to suggest alterations in the present method of production detailed information would be necessary not only concerning the method of extraction employed but also regarding the method of winning and drying the peat, the labour facilities, existing plant, power, etc. It would be advisable to carry out systematic research on the peat dried to different stages and treated with different solvents under varying conditions, etc.

On the other hand, if the economic situation permits the peat wax as produced hitherto could be de-asphaltised, in a comparatively simple manner, and would thus meet most requirements. In this process, however, a loss of about 25 per cent. would occur, and it does not seem likely that any use could be found for the "asphaltic" matter removed. It is considered that it might be more favourable to change the method of production. The resinous fraction would not be harmful in the peat wax if present to a limited extent; if separated it would most probably find application for purposes

similar to those for ordinary colophony owing to its resinous nature.

In its present state the peat wax would be worth about 80-85 per cent. of the value of montan wax. It may be that refined (and bleached) peat wax could not only successfully compete with refined montan wax but even surpass it in quality.

Conclusions

(1) The present sample of peat wax is similar in appearance and analytical figures to a sample of peat wax extracted in 1926 with benzene at the Imperial Institute from peat received from New Zealand.

(2) The present sample bears a strong resemblance in appearance and composition to montan wax, but it melts about 10°C . lower and contains a higher content of "asphaltic" constituents.

(3) In its present state the wax would be worth about 80-85 per cent. of the value of montan wax, and could be used for some of the purposes that montan fills, e.g. for boot polishes.

(4) Consideration might be given to the question of the removal of the "asphaltic" constituent, conceivably by extracting with petrol (b.p. 80-100° C.) the wax as yielded by benzene extraction, i.e. material similar to the present sample. Alternatively, the peat might be treated in some other way, other than by extraction with benzene, in order to produce a wax containing little, if any, of the undesirable "asphaltic" constituent. The latter suggestion would entail the carrying out of a certain amount of systematic research work.

The suggestion made to de-asphaltise the benzene-extracted peat wax with petrol should not mislead to the conclusion that the same result can be achieved by extracting the peat directly with petrol. In view of the fact that the "asphaltic" constituent is insoluble in petrol (b.p. 80-100° C.) whereas the remainder of the peat wax is soluble in that solvent, it is natural to suggest that the peat should be extracted with petrol with this boiling range, thereby obtaining peat wax of the desired quality. But against this it must be mentioned that in the previous investigation carried out at the Imperial Institute in 1926, extraction with petroleum ether gave a yield of only 3.35 per cent. from peat containing 9.8 per cent. of moisture, while benzene from the same material yielded 17.45 per cent. It may be that in the previous work the petroleum ether had a boiling range different from that of the petrol used in the present occasion (80-100° C.) but information on this point is lacking.

In the previous investigation tests were made using various solvents for extracting the wax from the peat, and benzene was selected as being the most suitable from the economic point of view. No work was carried out to determine the proportion of "asphaltic" constituent in the different waxes thus obtained.

GIGARTINA DECIPIENS FROM NEW ZEALAND AS A
SUBSTITUTE FOR IRISH MOSS, WITH SPECIAL
REFERENCE TO THE BREWING INDUSTRY

IN addition to the work carried out by the Botany Division of the Department of Scientific and Industrial Research, New Zealand, on agar agar production from *Pterocladia* spp., an account of which was published in this BULLETIN, 1941, 39, 355-358, the possibility of utilising other seaweeds is also being investigated by the Division. In August 1941 small samples of dried seaweeds, representing several species of *Gigartina* were sent to the Imperial Institute in order to ascertain whether they could be used as substitutes for Irish moss or carragheen (*Chondrus crispus*). They comprised the following species: *G. alveata*, *G. angulata*, *G. atropurpurea* (?), *G. clavifera*, *G. cranwellae* sp. ined., and *G. decipiens*.

Preliminary examination showed that of these species the most promising was *G. decipiens*, and it was suggested that a larger quantity of this seaweed should be sent over for more extensive investigation. Accordingly 7 lb. of dried, sunbleached *G. decipiens* from Wellington was forwarded to the Institute in May 1942. At the same time 7 lb. of *G. angulata* from Stewart Island was furnished. It was stated that both these species, and principally the latter, are being bleached and used on a large scale by brewery firms in New Zealand. Both species were examined in the Institute's laboratory, and the sample of *G. decipiens* was also submitted to commercial trials in the brewing industry. The present report is confined to the results obtained with *G. decipiens*. The seaweeds were also tested by a firm of manufacturing chemists, which puts up a special preparation of Irish moss; they proved to be unsuitable for this particular purpose.

The material as received consisted of small, narrow, branched ribbon-like pieces of dry seaweed, translucent and mostly light brown in colour, but a small amount of dark brown or black pieces was present. The sample was clean and free from loose sand and dirt.

The sample was somewhat darker in colour than commercial samples of Irish moss, and differed from the latter in general appearance. Irish moss as marketed consists of finer material in small bunches, i.e. not so broken up into small pieces as the New Zealand seaweed now under report.

Laboratory Examination

A representative portion was withdrawn from the sample, coarsely ground, and examined with the following results, which are expressed on the material as received:

		<i>G. decipiens.</i>
Moisture	per cent.	14.3
Proteins	"	11.1
Matter soluble in cold water	"	44.2
Matter soluble in hot water	"	63.0
Ash	"	15.4
Arsenic (As ₂ O ₃)	parts per million	4
Lead (Pb)	"	2

Irish moss usually contains about 7 per cent. of proteins, and yields from 8 to 15 per cent. of ash. In cold water about 47 per cent. is soluble, while boiling water extracts about 75 per cent. of solids.

Jellying Power.—The sample was compared with a sample of commercial Irish moss.

Aqueous mixtures of various strengths were prepared by heating with water; on allowing to cool the following results were observed:

G. decipiens gave a fairly stiff jelly at a concentration of 6 per cent. (weight/volume), equal to that given by Irish moss at a concentration of 4 per cent.

At equal concentrations the jelly yielded by *G. decipiens* was very slightly darker than the Irish moss jelly.

Heat Test.—The seaweed when heated at 100° C. gradually darkened in colour, finally turning black. Irish moss behaved similarly, and no material difference in the rate of the intensity of the darkening was observed.

Conclusions.—*G. decipiens*, both in composition and in general properties, is of the same type as Irish moss. It is largely soluble in cold water, and more so in hot, and contains a relatively large amount of protein, being in the latter respect appreciably superior to Irish moss. It possessed good jellying power, although somewhat inferior in this respect to Irish moss. The material should be of commercial value as a substitute for Irish moss for various purposes.

It will be observed that the present sample contains arsenic, which is a common feature of seaweeds of this type. Manufacturers using Irish moss prefer it to contain not more than 2 parts per million, though it may often contain 3 or 4 parts. The amounts present in the sample under report would probably be harmless for most purposes, but should be carefully considered in relation to the use for which the seaweed is employed.

The amount of lead present in the sample is harmless, and probably present as a natural constituent.

Brewery Trials

In view of the similarity in composition and properties with Irish moss, which finds a comparatively large market as a clarifying agent in brewing, it was expected that this purpose would be the most likely application for *G. decipiens*. Consequently samples of the material were submitted to a firm of brewers and three firms of manufacturers of brewers' materials, who kindly undertook to

carry out the requisite commercial trials. The results were as follows :

(1) *Trials at a brewery*.—Comparative tests were made by boiling portions of sweet wort with hops at the rate of 1 lb. per barrel together with (a) no addition, (b) Irish moss, and (c) *G. decipiens*, the latter two in the proportion of 2 lb. per 100 barrels. The following results were obtained :

		Wort.	Sediment.
(a) No addition	.	Slightly hazy.	Light, bulky.
(b) Irish moss	.	Fairly bright.	Compact.
(c) <i>G. decipiens</i>	.	Brilliant.	Compact.

Thus the sample of *G. decipiens* gave results superior to those yielded by Irish moss.

(2) *Trials by manufacturers*.—The three firms to whom the material was sent all reported that it was superior to Irish moss for the clarification of sweet wort, namely as a copper finings or clarifying agent employed during the boiling of the wort in the coppers.

Conclusions.—All the firms consulted referred to the important factor of arsenic content. In view of the recommendations of the Royal Commission on Arsenical Poisoning (1903) that any material entering into the composition of beer should contain not more than one hundredth of a grain of arsenic per lb. (equivalent to 1.42 parts per million), officers of the Customs and Excise who have the right of taking samples of any materials in breweries, may take prosecuting action if this limit is found to be exceeded. Consequently the present material with four parts of arsenic per million, though obviously incapable of rendering beer harmful at the rate it would be employed, does not comply with the recommendations. It is understood that Irish moss containing more than the limit is diluted to the requisite standard by mixing with a suitable material. There would appear to be no obstacle on this account to the use of *G. decipiens* provided the arsenic content is not appreciably higher than that of the present sample.

On these lines there would be a ready market for *G. decipiens* in the United Kingdom in competition with Irish moss for use as a copper finings.

HELICHRYSUM HOCHSTETTERI OIL FROM KENYA

THE sample of *Helichrysum hochstetteri* oil which is the subject of this report, was forwarded to the Imperial Institute by a planter in Kenya. It was stated to have been prepared from the tops of the flowering stems of this plant which is indigenous to the country. The yield of oil was given as 0.2 per cent. It was desired that the

sample might be examined with a view to determining whether it had any commercial value, and if so to what uses it might be put.

The sample consisted of 2 oz. of a clear, very pale yellow, limpid oil with a slight camphoraceous odour. It was submitted to a chemical examination with the following results :

Specific gravity at 15° C.	.	.	.	0.8780
Optical rotation α_{D}^{15} C.	.	.	.	-15° 40'
Refractive index n_{D}^{20} C.	.	.	.	1.4786
Acid value	.	.	.	0.6
Ester value	.	.	.	2.1
Ester value after acetylation	.	.	.	11.70
Phenols	per cent. v/v	.	.	2.0
Aldehydes	per cent.	.	.	nil
Solubility in 70 per cent. v/v alcohol	.	.	.	Insoluble in 10 vols.
Solubility in 90 per cent. v/v alcohol	.	.	.	Soluble in 10 vols.

The results of the examination show that the oil consisted very largely of terpenes with only small percentages of alcohols and phenols. Aldehydes were absent.

No reference has been found in literature to the volatile oil of *H. hochstetteri* or to its chemical composition.

Species of *Helichrysum* are included among those plants commonly called "Everlastings." Among the best known species are *H. angustifolium* D.C. (*H. italicum* G. Don) and *H. stoechas* Moench., found in countries bordering the Mediterranean on the north, such as France, Italy and Dalmatia; *H. saxatile* Moris, occurring in Sardinia and Sicily; *H. benthami* V. and H., in central Madagascar; and *H. arenarium* Moench., the Everlasting Flower cultivated in gardens as an ornamental plant. In Madagascar there also grows a plant known as "Rambiazina," the botanical identification of which has not been definitely established though it is thought that it may prove to be *H. benthami*.

The flowers of these plants contain a small percentage of volatile oil, which can be prepared from them by distillation in steam or by extraction with volatile solvents.

The various *Helichrysum* oils possess different odours. The odour of *H. angustifolium* oil may be described as resembling a mixture of roses, orange flowers and chamomile; that of *H. stoechas* as a mixture of roses, lime flowers and chamomile; that of *H. saxatile* as rose-like; that of *H. benthami* as a mixture of terpenes and roses, while that of Rambiazina is camphoraceous with a secondary balsamic and rosaceous note. *H. arenarium* oil in a diluted state smells like celery.

The constituents of *H. angustifolium* oil have been stated to be nerol (up to 37 per cent.), both in the free and the combined state as an ester; furfural; iso-valeric aldehyde; optically active pinene; free caprylic acid; eugenol; acetic acid (as acetates); and sesquiterpenes. One authority, however, expresses doubt as to the presence of important quantities of nerol in the oil distilled in

Provence. One observer has recorded the presence of 41.5 per cent. of geraniol, while another did not find any.

The principal constituent of *H. stoechas* oil is reported to be α -pinene, *H. arenarium* oil contains a stearoptene (m.p. 48-50° C.), insoluble in alcohol; an acid (m.p. 34-36° C.); and a small amount of a phenol, probably p-cresol. *H. benthami* oil contains about 50 per cent. of terpenes, especially laevo- α -pinene, 20 per cent. of an alcoholic fraction smelling of geraniol and citronellol; and dextrorotatory sesquiterpene compounds. In Rambiazina oil have been found 11 per cent. of terpene alcohols (borneol, geraniol and perhaps linalol); 2 per cent. of esters, especially bornyl acetate; 1 per cent. of phenols, among others eugenol; less than 1 per cent. of camphor; 32-34 per cent. of eucalyptol; and 15 per cent. of relatively non-volatile constituents such as sesquiterpenes.

Of the different species of *Helichrysum* to which reference has been made above, *H. angustifolium* is by far the most important as a source of a volatile oil. *H. stoechas* is also occasionally distilled on a commercial scale. Up to the present time the oils from the other plants are of scientific interest only. The oil of *H. angustifolium* is used in perfumery.

The oil received from Kenya was submitted to a firm of essential oil distillers and manufacturing chemists, who reported as follows:

"We have now had an opportunity of examining the sample of oil of *Helichrysum hochstetteri*. Our laboratory reports that the odour is very complex, but is something akin to Juniper and Origanum, and that in their opinion the only possible use would be in toilet soaps and dental preparations. Possibly small quantities would blend well in an Eau de Cologne perfume, but they do not anticipate that the oil would find any considerable demand."

The amount of the oil submitted, 2 oz., was too small for a detailed examination, which is necessary in the case of new material.

The present examination and commercial opinion do not indicate outstanding character for the oil, and a market as a cheap perfumery oil is suggested. It is not possible at present to carry this investigation further, and in view of recently imposed restrictions its import into this country in quantity would not be possible; if, however, the prospects of production of this oil are promising, a fuller investigation of its possibilities might be made after the war.

ESSENTIAL OILS FROM THE BELGIAN CONGO

By special arrangement the Imperial Institute has undertaken to carry out laboratory and intelligence work on behalf of Allied Governments domiciled in this country on the same terms as for Empire countries. In accordance with this arrangement the Institute has recently examined four samples of essential oils from

the Belgian Congo, forwarded by the Comité Spécial du Katanga. They consisted of geranium oil, basil oil, *Eucalyptus citriodora* oil, and an oil from an unidentified source, known as No. 137. The reports on the oils are given separately below.

GERANIUM OIL

The sample, measuring 600 ml., was labelled "Essence de Geranium Rosat 1940. Lettre 4898 du 19/7/41. C.S.K." The oil was clear and bright, dark greenish-brown in colour, and had an agreeable and customary odour.

The figures for chemical and physical characters of this sample obtained at the Imperial Institute are tabulated below, with the range of figures given by Gildemeister for commercial Algerian and Réunion geranium oils :

	Present Sample.	Commercial Geranium Oils	
		Algerian.	Réunion.
Specific gravity at 15.5° C./15.5° C.	0.8966	0.892 to 0.904	0.888 to 0.896
Optical rotation (10 cm.) α_D	-8.8° at 23.1° C.	-6.5° to -12°	-7.7° to -13.8°
Refractive index $n_D^{20.0}$ C.	1.4670	1.464 to 1.472	1.461 to 1.468
Acid value	8.7	1.5 to 9.5	1.5 to 12
Ester value	52.4	31 to 70	50 to 78
equivalent to geranyl tiglate . . . per cent.	22.1	13 to 29.5	21 to 33
Ester value after acetylation	226.8	203 to 234	206 to 233
Total alcohols, as geraniol, $C_{10}H_{18}O$. . . per cent.	72.1	66 to 78	67 to 77.6
Free alcohols, as geraniol, $C_{10}H_{18}O$. . . per cent.	57.7	—	—
Solubility in 70 per cent. w/v alcohol at 15.5° C.	Soluble in 2.5 vols. Faintly opalescent.	Soluble in 2 to 3 vols.	—

The results show that the physical and chemical characters of the present sample fall within the range of both Algerian and Réunion oils.

The oil was submitted to (a) and (b), chemical and perfumery manufacturers, and (c) essential oil brokers, who reported as follows :

(a) "This oil has normal characters. In comparison with Algerian and Réunion oils, it is somewhat inferior in odour value as it lacks the body of these. It would be about the same value as Kenya geranium oil though perhaps slightly superior. We consider it quite satisfactory for all commercial purposes, and its value would be about the price of Kenya oil in ordinary times, but with the famine prices of to-day the value might be anything up to 70/- per lb."

(b) ". . . we have had several deliveries of geranium oil of this type, and consider it the best substitute for Bourbon geranium oil.

"The sample you sent us has a lower refractive index than usual, approximately 1.4705, and optical rotation is also lower

usually -10 to -12. The lower refractive index is close to that of Bourbon oil.

"This type of oil sold quite well in pre-war days and at present would be bought in large quantities if available, as the rhodinol obtained from same is almost as good as that obtained from Bourbon geranium oil."

(c) "We have compared the sample with the oil we have been importing regularly for some time now and find no difference in the odour, and only very slight differences in the analytical figures. It is also similar to the Kenya oil and should fetch about the same price. In normal times the price is 1/- or two below that of the Bourbon and Algerian oils. At present the oil is worth about 65/- to 70/- per lb."

The present oil, though somewhat inferior in odour value as compared with Algerian and Bourbon oils, would in normal times compete favourably with Kenya oil, and in the present circumstances would realise good prices both as a perfumery agent and for the preparation of rhodinol.

BASIL OIL

The sample, measuring approximately 600 ml., was labelled "Essence de Basilic 1940. Lettre du 19/7/41. C.S.K." The oil was clear and bright, light reddish-brown in colour and possessed a pleasant spicy odour.

This sample was examined at the Imperial Institute with the following results, shown in comparison with figures for commercial sweet basil oils (French, German, Algerian and Spanish) :

	Present Sample.	Commercial Sweet Basil Oils.*
Specific gravity at 15.5° C./15.5° C.	0.9242	0.904 to 0.930
Optical rotation (10 cm.), α_D	-8.4° at 20.2° C.	-6° to -22°
Refractive index n_{D20}° C.	1.4898	1.481 to 1.495
Acid value	3.3	Up to 3.5
Ester value	2.9	1 to 15
Ester value after acetylation	127.9	114.8 to 130.2
Total alcohols, as linalool, $C_{10}H_{18}O$, per cent.	38.7	—
Free alcohols, as linalool, $C_{10}H_{18}O$, ..	37.9	—
Total phenols	5.0	—
Solubility in 80 per cent. w/v alcohol at 15.5° C.	Soluble in 0.9 vols.	Soluble in 1 to 2 vols.

* These figures are quoted by Gildemeister from "Bull. Roure Bertrand Fils," 1910, 39, October.

The above results indicate that the present oil has the normal characters of the Basil oils of commerce derived from plants of *Ocimum basilicum* L. vars. *thrysiflorum*, *crispum*, *album* and *purpurascens*.

The oil was submitted to two firms, (a) chemical and perfumery manufacturers, and (b) brokers, who reported as follows :

(a) "Compared with French oil this is inferior in odour value and more closely resembles the Madagascar oil. It could not replace French oil in perfumery or other purposes. It is therefore difficult to give a commercial value, but possibly you would find a buyer at about 7/6 per lb."

(b) "It has been our experience that the demand for this oil is so limited that new sources of supply should not be encouraged, and we should not care to express an opinion as to the value."

The present oil is of fair quality though inferior to the French oil, for which there is only a limited demand. In normal times it would be difficult to find a buyer for the present oil in this country, and currently the prospects are little better.

EUCALYPTUS CITRIODORA OIL

The sample was labelled "Essence d'*Eucalyptus citriodora* 1940. Lettre 4898 du 19/7/41. C.S.K." It consisted of approximately 500 ml. of a pale lemon-yellow coloured oil, faintly opalescent.

The results of the chemical examination carried out at the Imperial Institute are shown in the following table, together with figures given by Gildemeister for this oil:

	Present Sample.	Range of constants given by Gildemeister.
Specific gravity at 15.5° C./15.5° C.	0.8713	0.864 to 0.894
Optical rotation (10 cm.). α_D	+1.3° at 20.2° C.	-1.2° to +3.5°
Refractive index n_{D20} ° C.	1.4527	1.449 to 1.463
Acid value	3.2	—
Ester value	12.4	—
Ester value after acetylation	278.6	—
equivalent to total acetylisable constituents expressed as per cent. of monohydric alcohols; $C_{10}H_{18}O$	95.7	78.1 to 98.2*
Total aldehydes and ketones as citronellal	74.7	55 to 61
Solubility in 70 per cent. w/v alcohol at 15.5° C.	Soluble in 3.5 vols.	Soluble in 1 to 1½ vols., but sometimes as much as 10 vols.

* Figure obtained by Pfau, "Perfumery and Essential Oil Record," 1925, 16, 183.

These results indicate that the present oil has the normal characters of a *Eucalyptus citriodora* oil. It contains a fairly high proportion of citronellal. The Australian oil, which is the only oil of this species on the United Kingdom market, may contain up to 85 per cent. of citronellal, while experimental oils from Seychelles examined at the Imperial Institute have contained 80 to 82 per cent. The citronellal in the present sample, and in most citriodora oils, however, has a low dextro-rotatory activity, and is therefore not suitable for the manufacture of laevo-menthol, for which Java citronella oil is employed.

The opinions of two commercial firms, viz. (a) chemical and perfumery manufacturers, and (b) brokers, to whom the oil was submitted are given below:

(a) "This oil is normal in every way and possesses a good odour value equal to the standard commercial qualities on the market. In normal times the value of this oil would probably be less than that of Java citronella oil, but owing to the present position in the Far East there would be a good demand for this oil and it would probably fetch about 15/- a lb. though pre-war it would only be worth about 2/6."

(b) "This sample appears to be very similar in odour to samples we have received from Seychelles and Tanganyika. In 1941 we received a trial shipment of oil from the former Colony and this was sold at 5/- per lb.—about the same price as Java citronella. It is our opinion that *Eucalyptus citriodora* would have to compete in price with the citronella and lemongrass oils; the pre-war prices of these however were not sufficiently attractive to encourage the production."

Under present conditions this oil would find a ready market for perfumery, but would not be suitable for use as a source of *l*-menthol. In normal times it would compete with Java citronella oil and fetch a lower price than that oil.

OIL 137

This sample was labelled "Essence 137/1940. Lettre 4898 du 19/7/41 C.S.K." It measured approximately 100 ml. The oil was clear and bright, pale yellow in colour and had a pleasant odour of cloves.

The sample on examination at the Imperial Institute gave the following results:

Specific gravity at 15.5° C./15.5° C.	.	.	.	0.9895
Optical rotation (10 cm.), $\alpha_{D}^{20.2} C.$.	.	.	-22.0°
Refractive index $n_{D}^{20.0} C.$.	.	.	1.5256
Acid value, <i>circa</i>	.	.	.	14
Ester value	.	.	.	2.5
Ester value after acetylation	.	.	.	181.3
Total aldehydes, as cinnamaldehyde	.	per cent.	.	0.45
Total phenols	.	.	.	48
Solubility in 70 per cent. w/v alcohol at 15.5° C.	.	.	Soluble in 1 vol., Insoluble in 2 vols.	

The oil was submitted to three firms of chemical and perfumery manufacturers, (a), (b) and (c), whose opinions were as follows:

(a) "This seems to resemble a species of *ocimum* distilled in Tanganyika, the phenol and physical contents being very similar. The oil might find some use for flavouring purposes, and its value would be about 7/6."

(b) "Similar oils to the present one have been received from Tanganyika.

"The odour is very fresh and delicate and we are of the opinion that the oil should be very useful in cosmetics, dental creams, high-class shaving and toilet soaps and shampoos."

(c) "As far as manufacturing with this oil is concerned we think it could only be used for eugenol, but the percentage contained therein would not be sufficient to compete with eugenol ex clove oil. We feel sure that the isolation of eugenol from this oil would not be as satisfactory as from clove oil, and we therefore doubt that this product would be very advantageous as far as manufacturing is concerned.

"As to its value as an aromatic, here again arises the question as to whether this oil could be produced to compete with the many oils already used for perfuming the cheap types of household soaps."

The present oil would appear to be of promising value as a flavouring agent, and in the toilet soap and cosmetics industries. It would not be able to compete with clove oil as a source of eugenol.

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Inst. Pp. 29, 8½ × 5. (Dehra Dun, U.P.: Forest Research Institute, 1943.) Price As. 4.

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Annual Report of the Indian Lac Cess Committee for the year ending March 31, 1942. Pp. 28, 8½ × 5½. (Ranchi, Bihar: Indian Lac Cess Committee, 1942.)

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Natural Tanning Materials of the South-eastern United States. II. Domestic Leaf Sumac. A Practical and Satisfactory Substitute for Sicilian Leaf. By A. Russell. *J. Amer. Leath. Chem. Assoc.*, 1943, 38, No. 1, 30-34.

IMPERIAL INSTITUTE

CONSULTATIVE COMMITTEE ON INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

QUARTERLY BIBLIOGRAPHY ON INSECTICIDE MATERIALS OF VEGETABLE ORIGIN, NO. 23

(April to June 1943)

Prepared in collaboration with the Imperial Institute of Entomology and the Department of Insecticides and Fungicides, Rothamsted Experimental Station.

GENERAL

Sixty-first Annual Report of the New York State Agricultural Experiment Station, 1942. Records the results of investigations on insects attacking fruit and vegetables, the insecticides used included rotenone, pyrethrum and derris.

The Effect of Summer Sprays on San José Scale Control on Apple. By S. W. Harman. *Bull. No. 703, New York St. Agric. Exp. Sta.*, 1943, 63-64. Rotenone, pyrethrum and nicotine tested.

The Apple Sawfly *Hoplocampa testudinea* Klug on Vancouver Island, British Columbia. By W. Downes and H. Andison. *Proc. Ent. Soc. B.C.*, 1942, 39, 13-16. (*R.A.E.*, 1943, 31, A, Pt. 5, 211.) Experiments indicated that nicotine sulphate in summer oil spray reduced infestation; quassia extract also effective.

Spreaders for Codling Moth Sprays on Apple. By S. W. Harman. *Bull. No. 703, New York St. Agric. Exp. Sta.*, 1943, 36-38. The insecticides used included nicotine and rotenone (derris).

Sprays to Kill overwintering Codling Moth Larvæ. By M. A. Yother, F. W. Carlson and C. C. Cassil. *J. Econ. Ent.*, 1942, 35, No. 3, 450-451. (*R.A.E.*, 1943, 31, A, Pt. 3, 112.) Nicotine sulphate and pyrethrum tested.

The Asparagus Beetle (*Crioceris asparagi* L.) as a Pest of Asparagus in Eastern Washington. By R. L. Webster and R. D. Eichmann. *Bull. No. 425, Wash. Agric. Exp. Sta.*, 52nd Ann. Rep., 1942, 37-38. Both pyrethrum and rotenone gave effective control.

Notes on the Cherry Leafminer. By D. W. Hamilton. *Bull. No. 703, New York St. Agric. Exp. Sta.*, 1943, 59-61. Pyrethrum, nicotine and cube were the insecticides tested.

A Thrips injurious to Orchids. By E. N. Cory. *Amer. Orchid Soc. Bull.*, 1941, 9, No. 9, 234-237. (*R.A.E.*, 1943, 31, A, Pt. 3, 127.) A spray containing free nicotine scorched the plants, but satisfactory results given by some proprietary sprays; pyrethrum and talc fairly satisfactory.

Biology and Control of the Potato Flea Beetles in Eastern Washington. By R. L. Webster and others. *Bull. No. 425, Wash. Agric. Exp. Sta.*, 52nd Ann. Rep., 1942, p. 39. Rotenone effective but cost high and supply now inadequate; pyrethrum dusts unsatisfactory.

Control of the Rape Flea Beetle (*Psylliodes chrysocephala* L.) in East Holstein. By A. Meuche. *Z. Angew. Entomol.*, 1940, 27, 464-495. (*Amer. Chem. Absts.*, 1943, 37, No. 1, 215-216.) Pyrethrum, derris and nicotine tested; derris most effective.

Turnip Flea Beetles. By H. W. Miles. *J. Minist. Agric.*, 1943, 50, No. 1, 36-38. Nicotine or derris dusts successful in control of the pest.

Commercial Control of the Pepper Weevil in California. By R. E. Campbell and J. C. Elmore. *J. Econ. Ent.*, 1942, 35, No. 3, 369-373. (*R.A.E.*, 1943, 31, A, Pt. 3, 104.) Cube powder effective; pyrethrum dust gave little or no control.

Spraying and Dusting Experiments with Bush Lima Beans on Long Island for Control of the Mexican Bean Beetle. By H. C. Huckett. *Bull. No. 702, New York St. Agric. Exp. Sta.*, 1942. A summarised report of field experiments carried out from 1936-1941 inclusive for the purpose of comparing the merits of sprays and dusts containing pyrethrum and rotenone-bearing powders.

Investigations on the Control of the European Corn Borer. By R. L. Beard and N. Turner. *Bull. No. 462, Connecticut Agric. Exp. Sta.*, 1942, 551-591. (*Amer. Chem. Absts.*, 1943, 37, No. 7, 1825.) Compares the effectiveness of nicotine, derris (rotenone) and pyrethrum.

Mole Crickets (*Gryllotalpa* spp.). *Agric. Gaz. N.S.W.*, 1943, 54, Pt. 3, 21-23. Nicotine or derris spray satisfactory for control.

Peanut Leafspot and Leafhopper Control. By L. J. Miller. *Bull. No. 338, Virginia Agric. Exp. Sta.*, 1942. (*R.A.E.*, 1943, 31, A, Pt. 5, 204-205.) Pyrethrum and sulphur dusts effective against leafhopper but less effective than sulphur alone or Bordeaux mixture against leafspot.

Platynota stultana as a Pest of Field-grown Carnations. By R. M. Bohart. *J. Econ. Ent.*, 1942, 35, No. 3, 399-403. (*R.A.E.*, 1943, 31, A, Pt. 3, 106-107.) Lead arsenate and nicotine-bentonite left an objectionable residue on the plants and mixtures of pyrethrum and rotenone destroyed the natural bloom of the foliage.

Combination Rotenone-Nicotine "Blends" for Pea Aphid Control. By J. H. Lilly. *J. Econ. Ent.*, 1943, 36, No. 1, 85-97.

Studies on Ovicides for the Clear Lake Gnat (*Chaoborus astictopus*). By C. C. Deonier and A. W. Lindquist. *J. Econ. Ent.*, 1943, 36, No. 1, 54-56. Pyrethrum and nicotine were among the products tested.

Calcium Arsenate with and without Aphidices for Control of the Boll Weevil and Cotton Aphid. By M. T. Young, G. L. Garrison and R. C. Gaines. *Assoc. Southern Agric. Workers, Proc. Ann. Convention*, 1942, 42, 142. (*Amer. Chem. Absts.*, 1943, 37, No. 7, 1824.) Mixtures of calcium arsenate and 1 per cent. nicotine gave better aphid control and greater yields of cotton than did mixtures of calcium arsenate and 0.5 per cent. rotenone.

Seltene Schädlinge des heimischen Obstbaues. By F. Voboril. *Dtsch. Obstbau* (B), 1940, Pts. 7, 9, 12. *Z. Pfl. Krankh.*, 1942, 52, Pt. 11, 525. (*R.A.E.*, 1943, 31, A, Pt. 5, 227.) Derris or pyrethrum recommended against *Typhlocyba rosae* and nicotine against *Plesicoris rugicollis* in German orchards.

Experiments on the Control of the Plum Wasp *Hoplocampa fulvicornis*.

By P. Bovien and Chr. Stapel. *Tids. Planteavl.*, 1940, **44**, 700-730. (*Amer. Chem. Absts.*, 1943, **37**, No. 2, 495.) Quassia more effective than derris or nicotine.

Mushroom Insects: their Biology and Control. By C. A. Thomas. *Bull. No. 419, Pennsylvania Agric. Exp. Sta.*, 1942. (*R. A. E.*, 1943, **31**, A, Pt. 5, 205-206.) Nicotine effective fumigant against flies of the genera *Megaselia* and *Sciara* and these pests are controlled by dusts of pyrethrum and nicotine.

New Recommendations for Large Scale Control of the Sheep Tick in the North-east. By H. H. Schwardt and J. G. Matthysse. *J. Econ. Ent.*, 1943, **36**, No. 1, 105-107. Cube-sulphur and nicotine-sulphur dips found effective.

Tick Control with Special Reference to *Dermacentor andersoni* Stiles. By G. A. Mail. *Sci. Agric.*, 1942, **23**, 59-67. (*Amer. Chem. Absts.*, 1943, **37**, No. 9, 2506.) Derris effective but frequent treatments necessary; nicotine sulphate also used.

Warble-fly Dressing without Derris. *Chem. and Drugg.*, 1943, **139**, No. 3289, 182-183. Order requiring use of derris suspended; substitute dressing containing nicotine sulphate and method of making described.

The Bed-bug. Its Habits and Life History and How to Deal with It. By A. W. McKenny-Hughes and C. G. Johnson. *Econ. Series No. 5, Brit. Mus. (Nat. History)*. Refers to the use of sprays of pyrethrum, derris or their derivatives as controls in cases of mild infestations.

"T 14" ein neues pulverförmiges Mittel zur Läusebekämpfung der Tiere. By Kranich and Nöcker. *Z. Veterinärk.*, 1942, **54**, 45-49. (Abst. in *Vet. Bull.*, 1943, **13**, No. 4, 144-145.) Among insecticides tested as delousing preparations for animals pyrethrum and derris proved unsatisfactory for horses; tobacco dust mixed with an unnamed substance "T 14" proved fairly effective.

Insect Control in Food Production. By E. G. Thomssen and M. H. Doner. *Soap*, 1943, **19**, No. 3, 90-92, 115. An insecticide such as nicotine sulphate suggested for incorporation in the adhesive used in bags and containers; references to the value of pyrethrum as a protective film and as a powder.

The Search for New Insecticides. By L. H. Haller. *J. Chem. Educ.*, 1942, **19**, No. 7, 315-321. (*R. A. E.*, 1943, **31**, A, Pt. 4, 167-168.) Nicotine and compounds, pyrethrins, rotenone and related compounds, hellebore and quassia are discussed.

Rapid Insecticide Testing. Use of the Settling Mist Method for Testing of Vaporised Contact Insecticides against Houseflies. By T. C. Allen, R. J. Dicke and J. W. Brooks. *Soap*, 1943, **19**, No. 4, 94-96, 121.

Small Chamber Method for Testing Effectiveness of Insecticides against Houseflies. By C. W. Kearns and R. B. March. *Soap*, 1943, **19**, No. 2, 101-104, 128.

Deposits of Insecticidal Dusts and Diluents on Charged Plates. By G. F. MacLeod and L. M. Smith. *J. Agric. Res.*, 1943, **66**, No. 2, 87-95. Powders of plant origin gave heavy deposits on negatively charged plates and diatomites and clays heavy deposits on positively charged plates.

Insecticide Supply Outlook [in U.S.A.]. A Summary of the Raw Material Situation from the Angle of Agricultural Insecticides. By P. H. Groggins. *Soap*, 1943, **19**, No. 5, 98-99, 107. Position of rotenone, pyrethrum and nicotine referred to.

The Insecticide Supply Situation [in U.S.A.]. *J. Econ. Ent.*, 1943, **36**, No. 1, 137-138. Final Report of a Special Committee. The position of vegetable insecticides discussed.

ALKALOID-CONTAINING MATERIALS

Tobacco Products, including Nicotine and Nicotine Derivatives

The Standardising of a Laboratory Method for Comparing the Toxicity of Contact Insecticides. By F. O. Morrison. *Canad. J. Res.*, 1943, **21**,

Sec. D, No. 3, 35-75. Toxicity tests were conducted with nicotine sulphate and nicotine alkaloid using *Drosophila melanogaster* as test insects.

Annual Report of the Department of Agriculture, Ceylon, for 1941. Refers to the use of kerala-soap tobacco wash as giving effective control of the capsid bugs causing shoot die-back of cashew trees.

An Improvement in the Non-residue Apple Spray Schedule. By S. W. Harman. *Bull. No. 703, New York St. Agric. Exp. Sta.*, 1943, 17-18. Tests carried out with nicotine-summer oil spray and a new fungicide "Fermate."

Tests of Modified Mixtures for the Control of Bud Moth on Apple. By F. Z. Hartzell. *Bull. No. 703, New York St. Agric. Exp. Sta.*, 1943, 23-26. Nicotine mixtures tested.

New Phases of Rosy Apple Aphid Control. By F. Z. Hartzell. *Bull. No. 703, New York St. Agric. Exp. Sta.*, 1943, 26-30. Nicotine sulphate among products tested.

A Shortened, Intensive Summer Spray Program for Apples in Eastern New York: Second Report. By J. L. Brann, Jun., and D. W. Hamilton. *Bull. No. 703, New York St. Agric. Exp. Sta.*, 1943, 48-51. Nicotine sulphate included in the spray programme.

Soybean Phosphatides as Deposit-Builders in Nicotine-Bentonite and Lead Arsenate Spray Mixtures for Control of the Codling Moth. By L. F. Steiner, C. H. Arnold and J. E. Fahey. *J. Econ. Ent.*, 1943, 36, No. 1, 70-72.

Efficiency of Nicotine Sprays for Codling Moth Control in the Pacific North-west. By F. D. Dean and others. *J. Econ. Ent.*, 1942, 35, No. 3, 387-392. (R. A. E., 1943, 31, A, Pt. 3, 105-106.)

The Possibilities of Replacing Lead Arsenate in Control of Codling Moth and other Injurious Apple Pests by Insecticides Non-poisonous to Man. By R. L. Webster and W. J. O'Neill. *Bull. No. 425, Wash. Agric. Exp. Sta.*, 52nd Ann. Rep., 1942, 35-36. Commercial fixed nicotine used with lead arsenate in cover sprays generally failed to give adequate control.

Influences of Changes in Relative Humidity on the Effect of Certain Insecticides on Newly Hatched Codling Moth Larvæ. By L. F. Steiner and C. H. Arnold. *J. Econ. Ent.*, 1943, 36, No. 1, 117-118. Nicotine-bentonite one of the insecticides used in the tests.

Codling Moth Oviposition and Fate of Eggs. By S. A. Summerland and L. F. Steiner. *J. Econ. Ent.*, 1943, 36, No. 1, 72-75. Nicotine-bentonite spray treatments compared.

Currant and Gooseberry Aphides. *Adv. Leaf. No. 176, Minist. Agric. Lond.*, 1943. Nicotine wash among the materials recommended for control.

The Resistance of Citrus Thrips to Tartar Emetic Treatment in San Fernando Valley. By C. O. Persing, C. S. Barnhart, W. L. Worthy and A. M. Boyce. *Calif. Citrog.*, 1942, 28, No. 5, 24-25; *Citrus Leaves*, 1942, 22, No. 11, 3-4. *Amer. Chem. Absts.*, 1943, 37, No. 4, 1004. A number of insecticides were tested but nicotine sulphate-sugar was found to be the best control treatment in lemon groves where the thrips were resistant to tartar emetic.

Summer Oil-Nicotine Sprays for Oriental Fruit Moth Control on Quinces. By S. C. Mendall and A. W. Avens. *Bull. No. 703, New York St. Agric. Exp. Sta.*, 1943, 30-33.

Experiments with Di-nitro Insecticides and Oil Sprays for the Control of Pear Psylla. By F. G. Mundinger. *Bull. No. 703, New York St. Agric. Exp. Sta.*, 1943, 46-48. A comparison is given with a proprietary nicotine insecticide.

Control of the Woolly Aphis (*Eriosoma lanigerum* Hausmann) by Spraying and other Methods. By R. N. Singh. *Indian J. Agric. Sci.*, 1942, 12, Pt. IV, 588-602. Soft soap-nicotine spray for summer use and tobacco-rosin soap spray for winter were recommended.

Pumpkin Beetle (*Aulacophora hilaris* Bois). *J. Dep. Agric. Vict.*, 1943, 41, Pt. 1, 31-32. For control on young plants lime and tobacco dust is recommended.

Substitutes for Tartar Emetic and Sugar in [Gladiolus] Thrips Sprays. By F. Smith. *Gladiolus Suppl.*, 1943, 7, No. 1, 14-18. (*Amer. Chem. Absts.*, 1943, 37, No. 9, 2505.) Good results obtained with nicotine sulphate.

Notes on the Control of Cotton Aphids. By G. L. Smith, A. L. Scales and J. A. Fontenot. *Assoc. Southern Agric. Workers, Proc. Ann. Convention*, 1942, 42, 143. (*Amer. Chem. Absts.*, 1943, 37, No. 7, 1823.) Marked reductions in aphid populations were obtained using nicotine dusts.

The Tolerance of Larvæ of the Tobacco Moth (*Phlepsihontius quinquemaculata* Haw.) to Nicotine. By G. Beall. *Rep. No. 72, Ent. Soc. Ontario*, 1941, 24-25. (*R.A.E.*, 1943, 31, A, Pt. 3, 130.)

Uma praga seria das orquídeas (Tæniothrips xanthius). By E. R. de Figueiredo, Jun. *Bol. Soc. Brasil. Agron.*, 1942, 5, No. 3, 315-322. (*R.A.E.*, 1943, 31, A, Pt. 3, 126.) Lime-sulphur and nicotine gives control of this pest of orchids.

The Pea Mite and Red-legged Earth Mite. *J. Dep. Agric. Vict.*, 1943, 41, Pt. 3, 151-152. Nicotine preparations recommended for control.

The Pea Moth (Leaf Roller Moth)—an Enemy of the Pea that is Hard to Combat. By B. Schwan. *Statens Växtskyddsanst. Växtskyddsnot.*, 1941, 41-43; *Chem. Zentr.*, 1942, 1042. (*Amer. Chem. Absts.*, 1943, 37, No. 10, 2874.) In tests, the moth was controlled by nicotine compounds.

An Alternative Insecticide for European Corn Borer Control. By L. A. Carruth. *Bull. No. 703, New York St. Agric. Exp. Sta.*, 1943, 33-36. Preliminary experiments indicate that Black Leaf 155, a fixed nicotine preparation, satisfactory.

The Relative Susceptibility of the Sexes of *Drosophila melanogaster* Meigh. to Nicotine (Alkaloid) used as Contact Insecticide. By F. T. Lord. *Rep. No. 72, Ent. Soc. Ontario*, 1941, 32-34. (*R.A.E.*, 1943, 31, A, Pt. 3, 132.)

Japanese Beetle Insecticide. *Soap, Perf. Cosmetics*, 1943, 16, No. 1, 20. A spray mixture based on soaps, corrosive sublimate and nicotine.

Scale Insects. By J. W. Evans. *Tasm. Agric. J.*, 1942, 13, No. 4, 156-159. Mealy bugs can be destroyed by a spray consisting of white oil and nicotine sulphate.

Springtails (*Colembola*). *Agric. Gaz. N.S.W.*, 1943, 54, Pt. 1, 40-41. Use of nicotine sulphate spray and tobacco dust suggested.

Acidified Nicotine Sprays for Horn Flies on Cattle. By W. G. Bruce. *J. Kansas Ent. Soc.*, 1942, 15, 120-123. (*Amer. Chem. Absts.*, 1943, 37, No. 7, 1828.)

Bentonite in Insecticides. *Chem. Tr. J.*, 1943, 112, No. 2923, 504. Bentonite being used in U.S.A. as a fixative for nicotine.

Insecticide. U.S. Pat. No. 2,152,236. *Brit. Chem. Physiol. Absts.*, 1943, B, III, 73. A nicotine tannate compound.

Other Alkaloid-containing Materials

Control of Pests and Diseases of Flax and Hemp. By A. Nikiforov. *Khim. Referat. Zhur.*, 1940, No. 12, 37; *Len i Konoplyia*, 1940, No. 6, 45-47; *Amer. Chem. Absts.*, 1943, 37, No. 5, 1219. Anabasine sulphate among products tested.

INSECTICIDE MATERIALS CONTAINING ROTENONE AND ALLIED SUBSTANCES

General

Analytical Isolation of Rotenone from a Spray Solution. By F. A. Gunther. *J. Econ. Ent.*, 1942, 35, No. 3, 458. (*R.A.E.*, 1943, 31, A, Pt. 3, 114.)

A Review of the Insecticidal Uses of Rotenone and Rotenoids from Derris, *Lonchocarpus* (Cube and Timbo), *Tephrosia* and related Plants. II. Thysanoptera. By R. C. Roark. *U.S. Dep. Agric. Bur. Entomol. Plant Quarantine E-581*, 1942.

Rotenone for Apple Maggot Control. By R. W. Dean. *Bull. No. 703, New York St. Agric. Exp. Sta.*, 1943, 13-14.

A Study of Rotenone-bearing Dusts for Cabbage Insect Control. By G. F. R. Hervey. *Bull. No. 703, New York St. Agric. Exp. Sta.*, 1943, 39-43.

Comparative Tests of Certain Insecticides and Variations in Schedules for Cotton Insect Control. By J. C. Gaines. *J. Econ. Ent.*, 1943, 36, No. 1, 79-81. Calcium arsenate was compared with calcium arsenate-rotenone and calcium-zinc arsenate in the tests.

The Pickly Pear Cactus Thrips (*Rhopalothrips bicolor*). *J. Econ. Ent.*, 1942, 35, No. 3, 460-461. (*R. A. E.*, 1943, 31, A, Pt. 3, 115.) Rotenone sprays effective.

Control of Head Lice. *Pharm. J.*, 1943, 150, No. 4146, 140. Refers to Ministry of Health Memorandum No. 230a in which the use of derris or lonchocarpus cream is mentioned.

Lethane as Rotenone Extender. *Soap*, 1943, 19, No. 5, 117.

Stabilising Parasiticides containing Rotenone or Rotenoid Principles. By W. P. Ter Horst. U.S. Pat. No. 2,291,262. *Amer. Chem. Absts.*, 1943, 37, No. 3, 720.

Amend Rotenone Order. *Soap*, 1943, 19, No. 2, 119. Rotenone subject to strict and complete allocation in U.S.A.

Stabilised Rotenone Compositions. By L. J. Christmann and D. W. Jayne. U.S. Pat. No. 2,151,651. Use of aminophenols claimed.

Rotenone Smoke. U.S. Pat. No. 2,285,950. *Soap*, 1943, 19, No. 2, 113.

Rotenone Prices "Ceiled" by Office of Price Administration [U.S.A.]. *Oil, Paint Drug Rep.*, 1943, No. 2, p. 4.

Derris

The Determination of Rotenone in Derris Root. A Reply. By H. E. Coomber, J. T. Martin and S. H. Harper. *J. Soc. Chem. Ind. Lond.*, 1943, 62, No. 5, 73-75.

Life History and Control of the Cabbage Seed Weevil *Ceutorhynchus assimilis* in Western Washington. By E. P. Breakay and R. L. Webster. *Bull. No. 425, Wash. Agric. Exp. Sta.*, 52nd Ann. Rep., 1942, p. 40. Derris inconclusive.

Diamond-Back Moth (*Plutella maculipennis* Curtis). *Adv. Leaf. No. 195, Minist. Agric. Lond.*, 1943. Derris dust useful for control where lead arsenate not desirable.

Vapourer Moth. *Adv. Leaf. No. 25, Minist. Agric. Lond.*, 1943. Where a poisonous spray cannot be applied with safety a derris insecticide is recommended.

Horticultural Insecticides. *Manuf. Chem.*, 1943, 14, No. 6, 150. Brief reference to the use of derris dust for carrot fly.

Inert Mineral Dusts as a Means of Control for Potato Moth *Phthorimaea operculella* Zell. in Stored Potatoes. By G. A. H. Helson. *J. Comm. Sci. Industr. Res. Aust.*, 1942, 15, No. 4, 257-261. Of the mineral dusts tried as substitutes for derris, finely ground magnesite was most satisfactory in laboratory tests.

Derris Promoted. *Oil, Paint Drug Rep.*, 1943, 143, No. 20, 5. Reports visit of U.S. plant physiologist to Central America to look into question of derris production there.

Derris from Latin America. *Chem. -Tr. J.*, 1943, 112, No. 2920, 439. Derris cultivation to be developed in Latin America.

Lonchocarpus

Toxicity of Cube-Vegetable Oil Dusts to Two Species of Aphids. By N. F. Howard and J. W. Apple. *J. Econ. Ent.*, 1943, 36, No. 1, 59-62.

The Control of the Common Red Spider on Lima Beans. By H. C. Huckett. *Bull. No. 703, New York St. Agric. Exp. Sta.*, 1943, 5-7. Rotenone-bearing powder (cube) was of little value, except when mixed with sulphur.

PYRETHRIN-CONTAINING MATERIALS

Pyrethrum Analysis. A Modification of the Hydrogenation Method for Determination of Pyrethrins. By F. B. LaForge and B. B. Bendigo. *Soap*, 1943, **19**, No. 4, 100, 107.

Chemical Methods for the Determination of Pyrethrins. By N. W. Gillam. *J. Proc. Aust. Chem. Inst.*, 1942, **9**, 262-270. *Brit. Chem. Physiol. Absts.*, 1943, B, III, 71.

Constituents of Pyrethrum Flowers. XV. Presence of the Cumulated System in the Pyrethrolone Side-chain. By F. B. LaForge and F. Acree. *J. Org. Chem.*, 1942, **7**, No. 416-418. (*Brit. Chem. Physiol. Absts.*, 1943, A, II, 67.)

A New Active Constituent of Pyrethrum Flower. By D. N. Roy and S. M. Ghosh. *Nature*, 1942, **150**, No. 3796, 153. (*R. A. E.*, 1943, **31**, B, Pt. 3, 47.)

Active Principles in Pyrethrum. *Soap*, 1943, **19**, No. 4, 113.

Fly Spray Kill. A Study of the Synergistic Action of N-substituted Piperonylamides when incorporated in Pyrethrum Fly Sprays. By S. I. Gertler, J. H. Fales and H. L. Haller. *Soap*, 1943, **19**, No. 4, 105-107.

Study New Synergists. By S. I. Gertler, J. H. Fales and H. L. Haller. *Soap*, 1943, **19**, No. 5, 111. The effects of certain amides on the toxicity of pyrethrum solutions.

Roach Powders. What Composition for Poisonous and Non-poisonous Types in the Face of War-time Scarcities and Restrictions? *Soap*, 1943, **19**, No. 4, 97-98, 121. Discusses possibilities in view of restrictions on pyrethrum.

The Mode of Action of Pyrethrum on the Cockroach *Periplaneta americana* L. By D. N. Roy, S. M. Ghosh and R. N. Chopra. *Ann. Appl. Biol.*, 1943, **30**, No. 1, 42-47.

Action of Pyrethrum upon the German Cockroach. By J. M. Hutzel. *J. Econ. Ent.*, 1942, **35**, No. 6, 933-937.

Roach Powders. Study of Comparative Effectiveness of Insecticidal Powder Mixtures against the German Cockroach. By E. C. Klostermeyer. *Soap*, 1943, **19**, No. 2, 98-99, 109. Pyrethrum among the products tested.

The Effect of the pH of Emulsions on the Toxicity of Pyrethrum Extracts to Beet Aphids. By E. N. Savchenko. *Nauch. Zap. Sakharn. Prom.*, 1939, **16**, No. 1, 138-141. (*R. A. E.*, 1943, **31**, A, Pt. 4, 175-176.)

Results of the First Experimental Dusting with Pyrethrum of a Forest Infested with the Pine Moth (*Dendrolimus pini* L.). By Y. P. Portnuikh. *Lesn. Khoz.*, 1940, No. 7, 65-69. (*R. A. E.*, 1943, **31**, A, Pt. 4, 174-175.) Successful results obtained.

Die Trauermücke *Neosciara solani* Winn. als Schädling an Champignon-kulturen. By K. Flachs. *Prakt. Bl. Pflanzenb.*, 1941, **19**, 1-20. (*R. A. E.*, 1943, **31**, A, Pt. 4, 139.) Pyrethrum dusts or sprays for dealing with these pests, and nicotine solution for watering infested beds are recommended.

The Mineola Moth (*Mineola scitulella*) or Destructive Prune Worm. By W. E. Shull and C. Wakeland. *Bull. No. 242, Idaho Exp. Sta.*, 1941, p. 7. (*Exp. Sta. Rec.*, 1943, **88**, No. 2, 224.) Pyrethrum in emulsified oil most effective.

A New Pest of Snapdragon and Verbena. By E. Hixson. *J. Econ. Ent.*, 1942, **35**, No. 4, 605-606. (*R. A. E.*, 1943, **31**, A, Pt. 5, 202-203.) Pyrethrum gave control of *Teleonemia nigrina*.

Control of Tomato Fruit Worm *Heliothis armigera* Hbn. By R. D. Eichmann and R. L. Webster. *Bull. No. 425, Wash. Agric. Exp. Sta.*, 52nd Ann. Rep., 1942, 36-37. Pyrethrum added to mineral oil spray showed some superiority to dusting silks of maize with cryolite or calcium arsenate.

The Potato Leafhopper (*Empoasca fabae* Harris) a Pest of Alfalfa in the Eastern States. By F. W. Poos. *Leaf. No. 229, U.S. Dep. Agric.*, 1942, p. 7, reports that the application of a pyrethrum-sulphur dust mixture is effective for control.

Insect Control on Aircraft. By G. L. Dunnahoo. *Soap*, 1943, 19, No. 2, 111-113. Pyrethrum effective.

Tests of Fly Repellents of Known Ingredients and of Selected Commercial Sprays on Dairy Cattle. By A. O. Shaw and others. *J. Econ. Ent.*, 1943, 36, No. 1, 23-32. Pyrethrum-containing sprays were among those tested.

Pyrethrum in the Treatment of Pediculosis. By D. N. Roy and S. M. Ghosh. *Indian Med. Gaz.*, 1942, 77, 480-481. (*Pharm. Absts.*, U.S.A., 1943, 9, No. 2, 55.)

Fleas. *J. Dep. Agric. Vict.*, 1943, 41, Pt. 3, 153-154. Pyrethrum powder recommended for treatment of cats.

Histological Effects of Pyrethrum and an Activator on the Central Nervous System of the Housefly. By A. Hartzell and H. I. Scudder. *J. Econ. Ent.*, 1942, 35, No. 3, 423-433. (*R.A.E.*, 1943, 31, A, Pt. 3, 109.)

Diluents and Supplements for Lead Arsenate Dusts for Cabbage Worm Control. By G. E. R. Hervey and G. W. Pearce. *Bull. No. 703, New York St. Agric. Exp. Sta.*, 1943, 44-46. Lead arsenate-Pyrax-soybean oil dust was the most effective treatment.

Commercial Control of the Pepper Weevil in California. By R. E. Campbell and J. C. Elmore. *J. Econ. Ent.*, 1942, 35, No. 3, 369-373. (*R.A.E.*, 1943, 31, A, Pt. 3, 103-104.) Pyrethrum dust gave little or no control.

Control of the Corn Earworm by Clipping. By E. M. Emmert and W. A. Price. *Bull. No. 436, Kentucky Agric. Exp. Sta.*, 1942. (*Amer. Chem. Absts.*, 1943, 37, No. 10, 2874.) Clipping more effective and more economical than a pyrethrum-oil treatment.

New Insecticidal Material. Study of the Toxicity of alpha-beta dibromo-beta-nitroethylbenzene in oil sprays against Houseflies. By E. R. McGovran, M. S. Schechter and J. H. Fales. *Soap*, 1943, 19, No. 3, 107, 117. Tests showing the effectiveness of this compound in comparison with a pyrethrum spray.

A Combination of 2, 4-dinitro-6-cyclo-hexylphenol with Sulfur as a Substitute for Pyrethrum for Control of Potato Leafhopper. By D. M. deLong and G. L. McCall. *J. Econ. Ent.*, 1943, 36, No. 1, 112-113.

A Method of Handling Trays in Ainaikoi Pyrethrum Dryers. By G. Walker. *E. Afr. Agric. J.*, 1943, 8, No. 3, 169-170.

Australian Drug Manufacture. *Indust. Aust. Min. Stand.*, 1943, 98, No. 2511, 77. Reference to pyrethrum production in Australia.

Australian Pyrethrum Trials. *Chem. Tr. J.*, 1943, 112, No. 2921, 461.

Indian Pyrethrum Trials. *Chem. Tr. J.*, 1943, 112, No. 2915, 320. Brief note.

Kenya Pyrethrum Acreage. *Public Ledger*, 1943, No. 33, 137, 3.

Peru's Pyrethrum Trials. *Public Ledger*, 1943, No. 33, 189, 4.

Pyrethrum Supplies to Food Trade. *Public Ledger*, 1943, No. 33, 196, 1. Distribution of existing stocks to be made to food producing and food using industries.

Pyrethrum Outlook Clouded by Acute Rotenone Shortage. *Soap*, 1943, 19, No. 2, 115.

Insecticide. *Chem. Tr. J.*, 1943, 112, No. 2922, 486. Composition consisting of freon, sesame oil and pyrethrum supplied to U.S. Army contingents for overseas service; carried in pressure containers holding about 1 lb.

OTHER INSECTICIDE MATERIALS OF VEGETABLE ORIGIN

The Insecticidal Principle in the Fruit of the Amur Corktree. By M. S. Schechter and H. L. Haller. *J. Org. Chem.*, 1943, 8, 194-197.

Insecticidal Possibilities in the Yam Bean Seed. *Soap*, 1943, 19, No. 5, 105-107.

Castor Insecticide. *Soap*, 1943, 19, No. 4, 119. Use of "Spra-Kast" a new insecticide with a castor oil base used satisfactorily for protecting potato crops in Maine and citrus in Florida.

Sabadilla as Insecticide. *Soap*, 1943, 19, No. 4, 125. Studies being carried out by Wisconsin University.

BOOK REVIEWS

Books for review should be addressed to "The Editor," Bulletin of the Imperial Institute, South Kensington, London, S.W.7.

A BLACK BYZANTIUM. The Kingdom of Nupe in Nigeria. By S. F. Nadel, Ph.D. Pp. xiv. + 420, $8\frac{1}{2} \times 5\frac{1}{2}$. (London; New York; Toronto: The Oxford University Press, 1942.) Price 25s.

The investigations which form the subject of this book have been carried out under the auspices of the International Institute of African Languages and Cultures, with funds provided by the Rockefeller Foundation. Fellowships were granted for special studies under the research programme of the above Institute. Dr. Nadel, one of the original fellows, chose the Nupe of Northern Nigeria as his field of research.

The author has produced a comprehensive study of the Nupe people which will be widely welcomed, and has performed a valuable service in showing the very elaborate social organisation of this African community. It will be appreciated that there are a number of other equally important groups in both the Northern and Southern Provinces of Nigeria. These highly developed African societies deserve careful study and the most sympathetic understanding, as only thereby is their further development likely to progress.

By his work Dr. Nadel has shown himself to be an able student of African civilisations. He has provided not only a valuable and authoritative survey of his subject, but also a most interesting and readable account of the selected community. His contribution to African literature will be appreciated for the general picture that is printed of the make up of an advanced West African group; much in the general picture would be equally true for similar Nigerian communities.

In addition to important sections dealing with the organisation of the Nupe people and their political history, the book contains informative accounts of economic resources, agriculture and industries. In it a careful analysis is provided of many features of African social organisation not generally recorded in such detail elsewhere.

The utilisation of land is described. The common crop rotations and the local agricultural calendar are given in considerable detail. The elaborate organisation of labour for farm work is reviewed; in farming and in local industries the important distinction is shown between *bucá* and *efako* work. The various local industries, weaving, glass-working, metal-working, etc., are all carefully described. Some such as the above are organised in craft-guilds; other such as tailoring, straw-hat and mat-making, are practised individually. Considerable space is given to the economics of Nupe life.

The work is provided with a number of excellent illustrations,

and a useful index. Such studies by promoting a fuller understanding of the outlook and needs of colonial peoples, and of the special problems they present, should do much to facilitate Empire development and aid in the avoidance of serious errors on the part of the guiding race.

THE FREEZING PRESERVATION OF FOODS. By Donald K. Tressler, Ph.D., and Clifford F. Evers, B.S. Pp. xvi + 763, 8 x 5½. (New York: The Avi Publishing Company, Inc., 1943.) Price \$8.00.

The science of preserving food by means of cold has made considerable progress since the day when Francis Bacon caught a mortal chill carrying out an experiment in stuffing a fowl with snow.

Modern refrigeration may be considered to have begun when Dr. Carl Linde introduced the ammonia compression machine in 1875. To-day there are some 800,000,000 cubic feet of cold storage warehousing space in the United States of America.

Freezing shares with canning the advantage over cold storage at temperatures above freezing point that it eliminates the risk of spoilage by moulds and bacteria. Both processes may produce changes in texture, but the authors of this publication claim that in general freezing preserves the fresh colour, flavour and palatability of fruits and vegetables better than canning or any other known method of preservation. They emphasise the advantages of quick freezing over slow freezing, and devote a chapter to quick freezing systems, including a list of patents (mainly American) covering such systems.

They also have much to say regarding frozen food locker plants, a development which has done much to extend the advantages of refrigeration to American farmers, as well as the numerous types of freezing cabinets and farm freezing plants which bring these benefits even nearer to farm and home.

Changes occurring during the preparation, freezing, cold storage and thawing of foods form the subject of another chapter. This is followed by one on packaging materials and problems. Others deal at some length with the preparation and freezing of fruits, fruit juices, vegetables, meat, poultry, fish, shellfish and dairy products.

Modern refrigeration is considered by the authors to have reached its greatest triumph in the freezing preservation of vegetables, though it is not applicable to all vegetables. Those, in general, which are commonly cooked before eating give results as good as could be desired, cooked frozen peas, lima beans, broccoli, and many other vegetables being practically indistinguishable from the cooked fresh products. Others, however, which are eaten without cooking, such as celery, lettuce, cress, radishes, onions, tomatoes, cucumbers, etc., are rendered unattractive by freezing, and good methods for dealing with them still remain to be worked out.

Fruits also differ in their "varietal adaptability" to freezing. As a class they are the most difficult of all products to freeze without radical changes in appearance, texture, flavour and colour, and in almost all cases they require packing in sugar or syrup, or some other special treatment.

The storage, transportation and marketing of frozen foods is discussed, as is also their nutritive value, and a chapter on the cooking and serving of frozen foods is contributed by Professor Faith Fenton of the College of Home Economics of Cornell University.

The remainder of the book is concerned mainly with quality control, standards, and laboratory testing.

The volume is well illustrated and contains numerous bibliographical references. It can be thoroughly recommended to all concerned in this vital modern industry.

THE PRODUCTION OF SEED OF ROOT CROPS AND VEGETABLES. Imperial Agricultural Bureaux Joint Publication No. 5. Pp. 95, $9\frac{3}{4} \times 7\frac{1}{2}$. (Imperial Agricultural Bureaux, Central Sales Branch, Agricultural Research Building, Penglais, Aberystwyth, Great Britain, July, 1943.) Price 3s.

Prior to the outbreak of the present war this country, the Dominions, and also the United States, had been dependent to a considerable extent on imports of agricultural and horticultural seeds, appreciable quantities of which came from Central European countries. Since 1939 it has been necessary to replace previous sources of supply no longer available, to provide the means whereby food production might be increased, and as far as possible to render each country self-supporting on account of shipping difficulties.

Recent developments have occurred chiefly in connection with the production of seed of root crops and vegetables. It is to provide an account of these developments that this joint publication of the Imperial Agricultural Bureaux of Horticulture and Plantation Crops, East Malling, of Pastures and Forage Crops, Aberystwyth, and of Plant Breeding and Genetics, Cambridge, has been prepared. In a series of authoritative articles by various contributors a description is given of what has been achieved so far in the United Kingdom, in Canada, Australia and New Zealand, and in the United States. Some particulars are also given of the position in the Union of South Africa. Much progress that will have considerable permanent value has been attained.

The work concludes with a valuable review of the present position regarding the production of seed of temperate vegetables in the Colonial Empire, and with a list of the varieties of these that have been grown with success in various Dependencies. In this use has been made of published papers, especially those by the Director of the East African Agricultural Research Station, Amani, and in

particular the recent investigation undertaken by Dr. H. A. Tempany, Agricultural Adviser to the Secretary of State for the Colonies.

While circumstances vary greatly between individual Colonial territories, certain seeds, e.g. beans, peas, tomatoes and lettuce, can be fairly readily produced. Instances where less success is generally obtained include many of the Brassicas and the carrot. However, the full extent of what seed production may be possible in some areas is hardly yet clear. In damp tropical climates the question of proper drying and storage methods are likely to require investigation. In particular, Cyprus, Malta, Palestine and Mauritius are or apparently could be largely self-sufficient. It may be that in some Colonial areas there will prove to be scope for the multiplication of seed stocks on contract, thus providing Empire sources of United Kingdom supplies formerly obtained from foreign countries.

It is impossible to attempt any detailed review of the several valuable and interesting papers. The publication brings together a great deal of useful information and its appearance will be generally welcomed.

WEED CONTROL. By Wilfred W. Robbins, Alden S. Crafts and Richard N. Raynor. Pp. xi + 543, 9 x 6. (New York: McGraw-Hill Book Company, Inc. ; London : McGraw-Hill Publishing Co., Ltd., 1942.) Price 35s.

It has been estimated that the annual loss to American agriculture caused by weeds amounts to 3,000,000,000 dollars, a sum exceeding that jointly due to insect and animal pests, plant diseases, and diseases of livestock. Indeed, to quote the authors of this book, "the production of almost all crops is largely a battle with weeds."

The weapons with which this battle is waged are various. Tillage and cultural methods are part of the agricultural heritage of centuries, in which recent advances in scientific knowledge find their appropriate applications. Weed control by chemical means is more largely of recent development. It includes non-selective contact sprays ; selective sprays and dusts used, for instance, against broad-leaved weeds in cereal crops ; "translocated" herbicides which when applied to the foliage of deep-rooted perennial weeds find their way down into the roots and do their work without injury to the soil or to other plants ; and soil sterilants, temporary or "permanent." There are also biological methods, of which the outstanding instance is the control of prickly pear by *Cactoblastis* in Australia.

All these methods are treated fully in a number of chapters, followed by one devoted to machinery for applying herbicides, ranging from knapsack sprayers to aeroplanes.

Other sections deal with weed problems in particular types of territory such as grasslands and turf; alfalfa, small-grain and rice fields; orchards and vineyards; roadsides; irrigation ditches, etc.; and with the peculiarities and habits of particular weed plants as affecting their control.

The main object of the volume, "to assemble and review critically the various methods of weed control," is admirably achieved, and at the same time underlying principles are discussed in such a way as to give the reader a rational understanding of the technique which he is called upon to practise.

CHEMISTRY OF INSECTICIDES AND FUNGICIDES. By Donald E. H. Frear, Ph.D. Second Printing. Pp. viii + 300, 9 x 6. (New York: D. Van Nostrand Company, Inc.; 1943.) Price \$4.00.

The book was written as the result of a graduate course on insecticides and fungicides which was organised by the author for chemists and biochemists who felt that the courses available did not stress sufficiently the rapidly growing field of chemical endeavour. Unfortunately, the author's aim is also the limiting factor of this volume, owing to the fact that no text book can hope to keep pace with the advances being made in these two subjects. It must be said, however, that this compact treatise is the most complete work that we have yet seen, and the author deserves high praise for the manner in which he has so skilfully selected his facts from the mass of original papers and relevant critical discussions published throughout scientific literature.

The subject matter is divided into five sections, (a) stomach poisons or protective insecticides, (b) contact poisons or eradicant insecticides, (c) fungicides, (d) spray supplements and residue removal and (e) analytical methods. The first three sections deal with the source, use and chemistry of the materials at present in use as insecticides and fungicides. In section four, the author has collected together information which is an essential adjunct to the use of these materials, and the last section consists of a symposium of recognised methods of analysis.

Dr. Frear has obviously spent much time in ensuring that his facts should be correct so far as our present knowledge of insecticides and fungicides will allow, and we can recommend this excellent text book to those who wish for reliable information on these important subjects.

PERFUMES, COSMETICS AND SOAPS, with special reference to Synthetics. By William A. Poucher, Ph.C. Volume I. Being a Dictionary of Raw Materials together with an Account of the Nomenclature of Synthetics. Fifth Edition. 1941. Pp. x + 459.

$8\frac{1}{2} \times 5\frac{1}{2}$. Price 30s. Volume II. Being a Treatise on the Production, Manufacture and Application of Perfumes of all Types. Sixth Edition. 1941. Pp. xiii + 430, $8\frac{1}{2} \times 5\frac{1}{2}$. Price 30s. Volume III. Being a Treatise on Modern Cosmetics. Sixth Edition. 1942. Pp. xi + 234, $8\frac{1}{2} \times 5\frac{1}{2}$. Price 25s. (London: Chapman & Hall, Ltd.)

The three volumes of this valuable work of reference are obtainable separately and in a sense may be regarded as separate books. The latest editions maintain the high standard of previous editions, and much new matter has been included. In Vol. I, for example, the monographs on citrus oils have been expanded in the light of the author's visit to Calabria and Sicily, whilst the English lavender industry, with which he has been closely associated in recent years, receives more detailed treatment than before. Notes on a few new synthetics of special interest, and on some new volatile oils are also added. Monographs on flower perfumes are dealt with in Vol. II, and here the large amount of research work carried out in France and Switzerland in recent years on the constitution of some of the flower oils receives due consideration. The many new substances for use in cosmetics which have been introduced since the last edition of Vol. III was published (in 1936) have necessitated the addition of much new matter in this volume.

PRACTICAL PHARMACOGNOSY. By T. E. Wallis, B.Sc., F.I.C., Ph.C., F.I.S. Fourth Edition. Pp. ix + 235, $8\frac{3}{4} \times 5\frac{1}{2}$. (London: J. & A. Churchill, 1943.) Price 15s.

In preparing still another edition of this well-known work by a leading exponent of the subject (the third appeared in 1936—see this BULLETIN, 1937, 35, 137), the opportunity has been taken to make a slight re-arrangement of the contents. The text has been revised throughout and a certain amount of new matter has been added. For example, instructions for determining stomatal number and index have been added to the histological schedules and under quantitative analysis six new exercises have been introduced. Such pharmacognostic numerical data as are now available are given in an appendix.

AN INTRODUCTION TO INDUSTRIAL MYCOLOGY. By George Smith, M.Sc., A.I.C. Second Edition. Pp. xii + 260, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Edward Arnold & Co., Ltd., 1942.) Price 20s.

The new edition of this useful work follows the general lines of the original issue (see this BULLETIN, 1939, 37, 76). More attention, however, is devoted to the yeasts and related fungi, which now form the subject matter of a separate chapter. The opportunity has also been taken of making certain minor alterations and bringing the

matter up to date. There is, for example, in the chapter on Industrial Uses of Fungi, a new brief section, headed "Antibacterial Substances," which deals with penicillin, but the author has omitted to include this in the Contents List. Many new references are included in the lists of literature, and about a dozen new illustrations are included. The Index has also been expanded. All these improvements render the book still more useful to all interested in the practical application of "moulds" in industry. The whole book has been re-set with a view to economising paper, and although 40 pages smaller than the first edition the amount of reading matter is actually greater.

MINERAL RESOURCES

ARTICLES

BAUXITE IN TASMANIA¹

By W. B. WILLIAMS,
Director of Mines, Hobart

THE occurrence of bauxite in Tasmania has been established beyond the initial stages of identification and, although the average material is not regarded as high grade, proved and potential resources indicate a substantial volume of ferruginous bauxite commercially suitable for the production of aluminium. Initial stages of identification were succeeded by investigations to fix a minimum economic quantity of commercial ore and to establish deposits in localities beyond the extremities of any proved area for the purpose of rapid development should industrial requirements demand accessions to proved volumes.

Deposits at Ouse, Campbell Town, Swansea and St. Leonards have comprised the major set-up for a survey of known bauxites. The Ouse deposits offered the best advantages for immediate development, and this locality was selected for the purpose of fixing the initial objective of a minimum economic quantity of commercial ore. Prospecting and other investigation work in the Campbell Town, Swansea and St. Leonards areas has indicated that bauxite suitable for the production of aluminium occurs over extensive tracts of country distant from the Ouse deposits. Collectively, these deposits may yield a large quantity of ore, but development work is necessary to determine grades and volumes and to isolate blocks of commercial bauxite.

OUSE

A total of 1,206 ft. of shafting has been completed and the intersected bauxite has been channel sampled in lengths of up to 5 ft. and in the proportion of approximately 1 lb. weight of sample per foot of channel.

An occurrence on the Gladfield Estate was selected for the laying down of a systematic grid of shafts at intervals of approximately 200 ft. The bauxite occurs as a lenticular crust over an area of about 220,000 sq. yds. and with a thickness ranging up to

¹ Published with the authority of the Agent-General for Tasmania.

approximately 19 ft. The surface gradient is a little less than 6°. The overburden is generally less than 3 ft. and rarely in excess of 6 ft. The calculated volume in the inner area of this deposit is 500,000 tons of an average value per foot of sample of 41.2 per cent. of available alumina and 3.2 per cent. of free silica. The outer area represents fringes of the deposit and, although the fringes may provide a slightly less average grade than the inner area, selective production from the fringes should provide an additional 100,000 tons of commercial ore. In three other smaller deposits on the Gladfield Estate the available bauxite has been assessed at 75,000 tons, making a total of 675,000 tons of proved and probable bauxite on this estate. Thus developments on the Gladfield Estate readily fixed the initial objective of a proved minimum economic quantity of commercial bauxite, amenable to low-cost surface mining. From 44 analyses of Ouse bauxite, the average content of titanium dioxide is set at 2.17 per cent.

Substantial expenditure has not been merited in close shafting and developing other deposits, but the survey has been extended to other localities, and prospecting has been done to indicate possibilities and to prepare for systematic development should the proved grade attract the establishment of an aluminium industry and should the initial requirements of a possible industry demand the fixation of a greater proved volume.

Deposits of bauxite, which collectively contain a considerable volume of ore, also occur on Lachlan Vale, Lentwardine, Glen Dhu, Lawrenny, Kenmore, Cleveland, and other estates. On the whole the position at Ouse is that the aggregate importance of the unexplored deposits is at present indeterminate, but they are sufficiently widespread to encourage the belief that the potentialities of the district are not less than the originally claimed 2,000,000 tons.

Factors favourable to the mining of bauxite deposits at Ouse may be summarised as follows :

1. A proved minimum economic volume of commercial ore ;
2. Deposits of bauxite exterior to the proved area upon which development work is necessary but which are sufficiently widespread to encourage the opinion that the aggregate potentialities are not less than 2,000,000 tons ;
3. Ready accessibility ;
4. Low-cost mining for a considerable period ;
5. Coal of a suitable quality in the district ;
6. Hydro-electric power and a transmission line across the area ;
7. An abundant supply of water from a river system in the vicinity of the deposits.

CAMPBELL TOWN

Bauxitic crusts occur in extensive tracts of country in the Campbell Town district. Shafting and general prospecting have

revealed wide variations in mineral constituents. Patches of bauxite attractively high in alumina and desirably low in silica have been traced in the formations, but the extent of the commercial ore appears patchy. It is unlikely that the aggregate volume of grade ore would be great but selective methods and beneficiation may enable quantities of ore to be produced for despatch to a treatment plant within the State. Extensive development work is necessary to isolate patches or blocks of grade ore for quantity evaluation, and pending acceptance of the established grade for industrial exploitation substantial expenditure on development work has not been merited.

SWANSEA AND ST. LEONARDS

Deposits of bauxite at Swansea and St. Leonards have been definitely located but investigations have been limited to the searching of outcrops and some prospect shafting to determine ore types and possible grades. The indicated grade of bauxite is not higher than that of the proved bauxite at Ouse. The areal extent of the deposits and the prospect assays merit development work to isolate blocks of commercial ore, but expenditure hereon is undesirable until available grades of proved ore are accepted for the commercial production of aluminium.

Swansea.—Samples of bauxite from outcrops and prospecting shafts returned the following results :

Available Alumina. Per cent.	Free Silica. Per cent.
42.4	6.1
40.0	1.7
42.9	1.6
36.9	3.7
35.6	5.9
37.4	3.4
33.8	4.0
35.9	3.5

The investigating officer has recorded the following observations upon the situation and extent of the deposits :

“ It is anticipated that further work will establish the existence of ore of a reasonable grade, but until sufficient shafting is carried out, there will be no certainty that the deposits, as a whole, can provide a useful thickness of solid ore. As far as surface indications are concerned, only one major outcrop gives promise of providing a large bulk of solid bauxite.

“ This outcrop is situated on ‘ Riversdale ’ (Woburn) estate and is located just east of the Bicheno road at a distance of 1.2 miles from the Campbell Town road junction. The deposit has a probable area of 19 acres and has a good showing of solid ore on its eastern edge. Assuming an average thickness of bauxite of 10 ft. over the whole area, the upper limit of production would be in the vicinity

of half a million tons, but from conditions found to prevail in similar deposits elsewhere, it is considered unlikely that this figure would be realised.

"Another area of similar size on 'Riversdale' extends eastwards towards the Grange road from a point about 20 chains north of the junction of the Campbell Town and Bicheno roads. Solid material is exposed at the surface only on the north-eastern tip of this area, and, pending shaft sinking, its potential productivity is quite indeterminate. Between these two areas, minor outcrops of solid ore occur as remnants along a diabase ridge. These would perhaps provide useful ore in small quantities, but, even in aggregate they are insufficient to affect the general position.

"The principal outcrop on 'The Springs' estate is on the north-eastern side of the old disused road from Swansea to Campbell Town at a distance of 1.6 miles south-easterly from the State School on the present main road. The formation has a surface extent of about 9 acres strewn with bauxite boulders, but there is no solid ore outcropping. A small quarry, now partially filled in, provided blocks of bauxite for house-building purposes, but, on inspection of the buildings on which the stone was used, the impression is gained that solid bauxite was not plentiful in the quarry. There are several small patches of the bauxitic formation on this estate, but there is little evidence of solid ore at the surface, and failing satisfactory results from prospecting of the larger areas, they are not likely to be of any great importance.

"All outcrops in the district have low angles of dip and the removal of overburden would not be a serious problem. The bauxite obviously belongs to the same type of formation as that found in other parts of Tasmania, and its potential utility will remain speculative until a reasonable amount of test shafting has been completed. It should be realised, however, that the probable upper limit of production is less than 2,000,000 tons and that unless the deposits open up more favourably than surface evidence indicates, the total output capacity may be less than 1,000,000 tons."

St. Leonards.—In geological associations and in superficial physical characteristics, the bauxite resembles that occurring at Ouse, but shafting and sampling are necessary to determine grades and quantities. A disadvantageous feature is the probability of heavy overburden, but systematic development is necessary before grades, quantities and mining economics can be discussed. The investigating officer has recorded the following observations :

"There is an occurrence of bauxite about 1 mile north-easterly from St. Leonards Township. The outcrop is most conveniently reached by the Launceston-Scottsdale highway, being situated along a valley side approximately 30 chains south of that road at a distance of $5\frac{1}{4}$ miles from Launceston. The trend of the valley is from north-west to south-east with the bauxite outcropping along

the south-western flank and being exposed also across the head, or north-western end of the valley. Across the valley in a north-easterly direction, remnants of bauxite mark the termination of the formation against the diabase bed rock.

"The actual outcrop is continuous for about half a mile, but the extent of the formation is indeterminate because the bauxite passes under sub-basaltic sands and clays, and its degree of persistence under this cover to the north and west is unknown. The bauxite has a probable average dip of about 5 degrees in an easterly or south-easterly direction. This dip would tend to reduce the rate of increase in the thickness of overburden, but not sufficiently to prevent the handling of overburden from becoming a serious problem in the extraction of ore. To determine the available tonnage of bauxite, under a reasonable thickness of overburden, it would be necessary to put down a number of shafts or bores away from the outcrop. The extraction of bauxite by methods of underground mining would be difficult on account of the nature of the sub-basaltic sediments which would form a dangerous roof to the workings, particularly under wet conditions. Shafting would also be necessary to determine the average thickness of commercial ore and to establish its grade. Assay results are at present available from only three samples. These were of surface material and, not being representative samples, they should be regarded as an indication only of the probable grade."

The results were :

				% Alumina	% Silica
No. 1 (Pisolitic)	.	.	.	45.42	5.99
No. 2 (Pisolitic)	.	:	:	43.67	2.53
No. 3 (Ochreous)	.	:	:	37.32	7.66

THE NATURE AND ORIGIN OF TASMANIAN BAUXITE¹

By D. R. DICKINSON,
Mines Department, Hobart

THE physical characteristics of the known bauxitic formations of Tasmania differ widely in the various localities, but the geological associations are markedly similar and there is every reason to believe that the deposits belong to the one epoch, and that they have been derived by similar processes. No detailed petrological work has yet been carried out, but the originally stated view that the bauxite had originated from the decomposition *in situ* of volcanic tuff accumulations is considered sound.

At Ouse, the bauxite is generally preserved in basin-shaped depressions in diabase (dolerite). Apparent bedding planes may be

¹ Published with the authority of the Agent-General for Tasmania.

seen in many of the prospecting shafts, and there is a strong probability that the majority of the material is water sorted. Post bauxitic faulting is indicated by the variable dips prevailing both in the bauxite and in the overlying Tertiary sediments.

At Campbell Town, water sorting was less prevalent, and as the deposits are generally flat lying, or possessed of low dips corresponding with a surface of flowage, there is no evidence of recent faulting. The outcrops broadly comprise a series of flat-topped ridges with substantially the same trend as the present valley system. Other similar "flat tops" in the district are capped by "Newer Basalt," and there appears to be a strong analogy between the two types of formation.

In both localities the bauxite is considered to represent the remnants of an early Tertiary volcanic phase, which was succeeded, or perhaps accompanied by, the deposition of sands and clays with isolated areas of lignite. The series in the Ouse district was subsequently covered by extensive flows of Newer Basalt which filled the river valleys, and still cap much of the surrounding land. At Campbell Town basalt also covered large areas and in all probability extended over the bauxite ridges.

As far as has been observed, the alteration processes bringing about the desilication of the parent material have been less effective in the Campbell Town area, particularly as regards the vertical extent of the resultant bauxite. At Campbell Town there also appears to have been a more general tendency for the leached iron to be reprecipitated in the immediate vicinity, and this has resulted, over the bulk of the deposits, in the non-siliceous product being an intimate mixture of the hydroxides of iron and aluminium, the iron frequently being dominant.

This fact was not at first evident as the original surface samples were most encouraging, one reaching the grade of 51.3 per cent. Al_2O_3 , 1.76 per cent. SiO_2 , 15.87 per cent. Fe_2O_3 , 1.6 per cent. TiO_2 and 27.72 per cent. ignition loss. Several other samples were almost as good, and similar material may still be picked up along the surface of some of the "flat tops." Sub-surface sampling, for the most part, revealed ore of a much lower grade, the solid formation being richer in iron and poorer in aluminium, although the silica percentage was found to be similarly low in both cases.

One type of enrichment in alumina may be illustrated by the section of Shaft No. 8 at Meadowbank, where sample No. CC18 returned 36.2 per cent. of alumina and 6.2 per cent. of silica by the caustic soda method. The ore in this section consists of hard nodules in a softer, tougher matrix. Selecting the hard nodules only, the assay result improved to 51.0 per cent. of alumina and 1.1 per cent. of silica. These nodules are apparently concretionary and have probably been deposited from colloidal solution about nuclei in the partially altered parent rock. The nodules themselves are fine grained, hard and brittle. Similar material also occurs in bands

close to the surface, with little or no matrix, but under these circumstances there is usually a much higher proportion of ferric oxide and a lower alumina content. Substantial quantities of this ore could be isolated in bands of up to 6 ft. in thickness, but the average alumina content would probably not exceed 35 per cent.

In zones of more complete alteration the distinction between matrix and nodules practically disappears, and the whole rock becomes a mottled heterogeneous mass, often quite friable and rotten. This is typically the best ore and provided the material of the higher grade surface samples, but it has only been located in narrow bands of limited areal extent. It is characterised by patches and cavity linings of pale green to iron-stained gibbsite, often exhibiting mammillary structure. Thin seams of limonite are common and small pockets of kaolin also occur. The outlines of large felspar crystals are sometimes perfectly preserved, and recognisable fragments of basalt leave little doubt as to the origin of the material.

Typical ore of the Ouse district, by contrast, is much more constant in texture, particularly in the deeper parts of the basins. There is frequently an iron-rich zone close to the surface where rhythmic precipitation has produced pronounced pisolithic structures. The pisolithes may carry alumina in excess of ferric oxide and sometimes comprise first-grade ore. At its base the bauxite usually rests on a thin band of clay which, in turn, overlies the partially decomposed diabase. The bottom layer of the bauxitic formation commonly carries a second concentration of iron, usually impregnating dense, finely-grained ore. The iron also accumulates as thin inter-stratified bands of limonite and, more rarely, as hematite. It appears to have been deposited from stagnant solutions trapped by the impervious clay band. The bulk of the commercial ore lies between these two iron-rich zones, and is generally fairly uniform in texture and grade, but carries nodules showing the concentric precipitation of iron outwards from a more or less completely leached centre.

The normal type of bauxitic formation at Ouse may be described as a lenticular ore-body, often contaminated with clay at the fringes, but relatively homogeneous as regards the central portions. At Campbell Town the ore of commercial grade occurs as small lenses in formations which, in bulk, carry too much iron and too much silica to be regarded as bauxite.

Many and varied suggestions have been made as to the chemical processes by which silicate minerals can yield the hydroxides of aluminium and iron as a more or less silica-free residue, or as a transported deposit. It is generally agreed that carbonic acid and other solutions from decaying vegetable matter are active solvents of both iron and silica. At Ouse, lignitic formations occur in the overlying sedimentaries in close proximity to the bauxite, and it is feasible that, during the laying down of these lignites,

conditions prevailed whereby decomposing solutions could have ready access to the waterlogged and porous volcanic tuff accumulations. The iron and silica thus taken into solution would be transported as hydrosols and precipitated when circumstances became favourable. The ferric oxide would precipitate more readily than the silica, particularly if precipitation were dependent on the presence of electrolytes. This would explain the large proportion of the original iron content retained in the immediate vicinity of the bauxitic formations, as compared with the more complete removal of silica. It also provides a reasonable explanation for the frequent concretions of limonite found in the Tertiary sands immediately overlying the bauxite at Ouse.

The following criteria are suggested as having controlled the formation of the Tasmanian bauxites, and may be invoked to account for the wide variations observed both in the depth, and in the fluctuating alumina, ferric oxide and silica contents of the various deposits :

1. The nature of the original material, particularly as regards its chemical composition, its thickness, and its permeability to solutions.
2. The presence of active solutions, such as those from decomposing vegetable matter.
3. Conditions of drainage and their effect on the transport and precipitation of materials in solution.
4. Climatic influences, including the alternation of seasons.

ABSTRACTS AND NOTES

Obituary.—W. Forster Brown.—We greatly regret to record the death on July 18, 1943, of Mr. Westgarth Forster Brown, C.B.E., M.Inst.C.E., M.Inst. M.M., M.I.Min.E., F.S.I., the well-known mining engineer and consultant. He began his long and varied career in the mining industry in 1885 as a pupil-apprentice at the Whitburn Colliery while at the same time attending courses at the Armstrong College of Science, Newcastle. This was followed by experience at several other collieries in this country until in 1888 he became associated with the firm of Forster Brown & Rees, Mining Engineers, becoming a partner in 1895. During that period his work entailed lengthy visits to New Zealand, New South Wales and South Africa, chiefly in connection with the investigation and development of coal mines.

In 1903 Mr. Forster Brown was appointed Chief Mineral Surveyor to H.M. Woods and Forests (now the Forestry Commission) and Deputy Gaveller of the Forest of Dean. He also acted up to the time of his death as Chief Mineral Adviser to the Duchy of Cornwall and to the Commissioners of Crown Lands, and in 1939 he was awarded the C.B.E. in recognition of his valuable work.

His close association with the work of the Imperial Institute dates from 1925 when he became a member of the Advisory Council on Minerals on the amalgamation of the Institute with the Imperial Mineral Resources Bureau on whose Board of Governors he had served for several years. He also served as a member of the Mining Law Committee of this Institute from 1925, becoming Chairman in 1935, and it is particularly in this connection that he will be remembered here, for he was at all times ready to place his long and varied experience and knowledge unreservedly at the service of the Institute. In this direction Mr. Forster Brown rendered particular service to the Empire by giving invaluable advice on numerous problems in mining law as it affects the exploitation of Empire mineral resources.

H. M. Ridge.—The sudden death at his home in Crouch End, London, of Harry Mackenzie Ridge, M.E. (Freiberg), M.Inst.M.M., M.I.Chem.E., F.Inst.F., F.G.S., on August 4, 1943, at the age of 70 brings to a regrettable end the life of a distinguished and indeed world-famous mining and metallurgical engineer, whose advice and guidance were always unstintingly at the service of this Institute. For many years Mr. Ridge had been one of the most active members of the Imperial Institute Consultative Committee on Base Metals, and gave invaluable advice regarding the mineral monographs which were published under the approval of this Committee.

Mr. Ridge was born in London on February 20, 1873, and received his early education at Christ's Hospital, Newgate Street, E.C., an ancestor having been one of the original founders of this school. Later he studied mining engineering and mine surveying under Professor Schnall at Freiberg in Saxony and obtained the Diploma of Bergingenieur und Markscheider; he also held a Law Degree, but this he seldom referred to, and details are not available for record.

In 1899 Mr. Ridge went to Australia as Manager of the Australian Metal Company's works at Broken Hill, and occupied this position until 1905, when he returned home to become General Manager of the Central Zinc Co., Ltd., Seaton Carew, Co. Durham, and a Director of the Central Acid Co., Ltd. In 1909 he relinquished his position as Manager of the Central Zinc Company and commenced to practise as a consulting mining and metallurgical engineer, specialising in the treatment of ores containing silver, lead, zinc and other non-ferrous metals. He was perhaps best known for the "Ridge Roasting Furnace," and as Principal of Messrs. Ridge Roasting Furnace and Engineering Company was responsible for the erection of numerous metallurgical, chemical and mining plants throughout the world.

Mr. Ridge had an exceptional knowledge of the European countries, Germany in particular, and spoke several foreign languages fluently; this served him in good stead when he was associated

with the Imperial Institute Intelligence Section which was seconded to the Ministry of Economic Warfare for the first six months of the present war. Just prior to his death he had been engaged in the design and construction of plant for war purposes.

Apart from Mr. Ridge's numerous business activities, he was ever ready to help others, and in particular did his utmost for those true refugees from Nazi oppression who had fought against it in their own countries.

Dr. R. C. Wilson.—With the death of Dr. R. C. Wilson, Director of the Geological Survey of Nigeria, we have to record with deep regret the loss of yet one more of those pioneer geological surveyors who in the earlier years of the present century carried out valuable geological exploration in Africa.

Reginald Charles Wilson, D.Sc., F.G.S., Assoc. Inst. M.M., was an Australian, born in Melbourne in 1888. He entered the University of that city with the intention of becoming a mining engineer, but after two years study decided to concentrate on geology and graduated in science in 1910. It was in the following year that he commenced his life's work in Africa as assistant to E. O. Thiele (now Sir Edmund Teale) on the Mineral Survey of the territory of the Mozambique Company in Portuguese East Africa, which was carried on until 1915 under the direction of this Institute. During the Great War he served with the Royal Welch Fusiliers and the Royal Engineers, on active service in France with the rank of Captain. In 1919 he returned to geological work in Africa as an officer of the Geological Survey of Nigeria where he was chiefly engaged on the investigation of the tinfields and coalfields of the country. Dr. Wilson became Director of the Survey in 1927 and continued in this office until his untimely death in Lagos on May 7, 1943.

In addition to innumerable official reports his published contributions to scientific literature included a paper (with E. O. Thiele) on the physiography and tectonics of Portuguese East Africa (*Geogr. J.* 1915, 45, 16-45), and he was part author of *Bulletins* 2, 8 and 12 and *Occasional Papers* 1 and 6 of the Geological Survey of Nigeria. As was mentioned in the previous issue of this BULLETIN (1943, 41, 122) the work of his Department greatly expanded under his direction, especially in regard to the vital matter of water supply in the Colony, and his enterprise in establishing a museum and laboratory in Nigeria has been of great value to the public in general and to the mining community in particular. Dr. Wilson always maintained a close association with the Imperial Institute, and his death will be specially felt by many members of the staff by whom he was regarded as a personal friend of many years standing.

Big Diamonds from Sierra Leone.—In a previous issue of this BULLETIN (1937, 35, 333) a description was given by J. D. Pollett, of the Geological and Mines Department, Sierra Leone, of the diamond deposits of that Colony. By the courtesy of Sierra Leone Selection Trust, Limited, the Imperial Institute is now able to announce the discovery in June 1943 of a gem diamond of exceptional size, weighing about 530 carats. Stones approaching such proportions have never before been found in any of the diamond deposits of Africa excepting those in the Union; indeed, this Sierra Leone stone ranks as one of the world's greatest gem diamonds. Although records of the original weights of some of the ancient Indian stones are unreliable, it is unlikely that more than seven or eight larger diamonds have been found in the world. Four of these (Cullinan, Excelsior, Jonker and Jubilee) came from the Union of South Africa and the others from Brazil and India. The new stone has not yet been named, and a detailed description is not yet available, but it is hoped to publish a full account, including the circumstances of its recovery, in a future issue of this BULLETIN.

It may also be stated that a gem stone of about 250 carats, the second largest stone from West Africa, was recovered from the same Sierra Leone alluvial deposit in March of this year.

Diamonds in the Gold Coast.—In 1938 the exports of diamonds from the Gold Coast, amounting to over one and a quarter million carats, were the largest in the British Empire and were, in fact, second in quantity only to the production of the Belgian Congo. From its inception in the early 1920's to the end of 1940, the Gold Coast industry had produced altogether about 15 million carats (or 3 tons) of diamonds valued at approximately £8 million sterling.

An account of this industry, which has had such a remarkably rapid rise, has lately been given by the Director of the Geological Survey, Dr. N. R. Junner, in "The Diamond Deposits of the Gold Coast," *Gold Coast Geol. Surv. Bull.* No. 12, 1943, from which the present account is abstracted.

There are two diamond fields in the Gold Coast, the Birim field, which is exploited chiefly by European enterprise, and the Bonsa field, which is worked by natives. In addition to these, there are several minor occurrences which have either been actually worked or carefully prospected at various times but without any great success.

The Birim field, which has been responsible for 98 per cent. of all diamond production in the Colony, is approximately 380 sq. miles in extent and is situated about 60 to 80 miles north-west of Accra in dense tropical forest country at an average elevation of between 400 and 550 ft. above sea level. The area is one of low relief with the wide, flat-bottomed, steep-sided valleys and sharp ridges typical of sub-aerial erosion in a humid tropical climate.

The solid and superficial formations in this area are :

SUPERFICIAL DEPOSITS . . .	Gravels, sands, clays, laterite and soils. (Pliocene (?) to Recent)
BASIC INTRUSIVES . . .	Dolerite, epidiorite and other basic sills and dykes. (age uncertain)
ACID INTRUSIVES . . .	Older and Younger granite, aplite, porphyry, (Post-Birimian) pegmatite and quartz veins.
BIRRIMIAN (Pre-Cambrian) .	Greywacke, phyllite, tuff, schists and basic hypabyssal and extrusive igneous rocks.

The superficial deposits occur in the stream valleys, on river terraces, and the sides and tops of hills and ridges. Rounded, closely-packed pebbles of quartz make up 95 per cent. of the gravels, the remainder being hornstone and greywacke.

The Birrimian rocks have a regional strike trending in a general north-easterly direction, and are always more or less metamorphosed. True kimberlite, the host rock of South African pipe diamonds, which gives rise to the famous blue ground, is unknown in the Birrimian, but ultrabasic rocks similar in composition to picrite and oceanite occur. Granites, aplites, porphyries and dolerites are intruded into the Birrimian and are therefore younger.

The diamonds produced in the Gold Coast come preponderantly from alluvial deposits in the beds and flats of streams, in terrace gravels and in lateritised hill-top gravels, all overlying Birrimian rocks with granitic intrusions, but in no case are diamonds known to occur in the gravels of streams draining exclusively granitic rocks. Some of the richest concentrations occur in zones striking parallel to the underlying Birrimian rocks, and the largest and richest concentrations of diamonds are found in the valleys of very small streams, especially those with flat gradients and wide flats.

One of the most characteristic features of Gold Coast diamonds is their small size, no stone larger than $4\frac{1}{2}$ carats having been found in either the Birim or Bonsa fields, although one of $10\frac{1}{2}$ carats was discovered in the Volta river in the Northern Territories. All stones down to 0.5 mm. are now recovered, and those less than 2 mm. account for more than 50 per cent. of the weight and about 90 per cent. of the number of stones produced. Other characteristic features of the diamonds from the Birim field are the high proportion of boart (35-40 per cent. in the Birim valley) and of brown, grey and pale green stones, the rarity of yellow stones, and the extreme rarity of worn stones. Octahedral crystals with plain reflecting surfaces ("glassies") are the commonest type of diamond found, dodecahedral crystals with curved faces are also quite common, and so are macles, but cubes are rare.

Associated with the diamonds are a number of other "heavy minerals," notably staurolite (of which there is a dump of some 50,000 tons at one mine), ilmenite, limonite, rutile, rutile-quartz and tourmaline. In addition there is a wide variety of rare minerals

in the concentrates. The proportion of these concentrates to the gravels varies from property to property and in different parts of one deposit. The variation is between 1.5 and 0.06 per cent. by volume, whilst the average for all the workings is 0.17 per cent.

The method of operation in this field is generally to clear the bush and remove the overburden after which the gravel is excavated and then removed to the plant, where the concentrates are obtained by pans or jigs. These concentrates, after passing over a magnetic separator, which removes most of the staurolite, ilmenite, magnetite, haematite and limonite, are again jigged and then sorted. The method is not entirely satisfactory, however, and one company has installed grease tables for recovering the diamonds from the concentrates, an innovation which has resulted in a notable increase in all-round efficiency.

The diamond content of the gravels has fallen from 1.9 carats per cubic yard in 1929-30, when 383,600 cubic yards were treated, to 1.6 carats per cubic yard in 1938-9, when 889,930 cubic yards were worked. In 1938, when the average price was 8/- a carat, half a carat per cubic yard was the least content that could be profitably worked by one of the companies.

Gold Coast diamonds, which are subject to 6½ per cent. *ad valorem* export duty, are chiefly used for industrial purposes, though a moderate proportion is of gem quality.

The Bonsa diamond field is approximately 25 miles north-west of Takoradi, and is underlain partly by Upper Birrimian greenstones and by arenaceous Tarkwaian sediments of the Kawere and Banket series. The diamondiferous gravels consist of sub-angular and rounded pebbles derived from the Kawere conglomerate and angular quartz from Tarkwaian and Birrimian veins all contained in a sandy matrix. These deposits are, however, patchy and of low grade, averaging at the best only between ½ and 1 carat per cubic yard, and are of no interest to European concerns, though they are spasmodically worked by the local natives, by washing in wooden calabashes, for an average output of about 3,000 carats per month. In almost every way the diamonds are identical with those from the Birim field, but the amount of associated heavy minerals, especially staurolite, is rather less.

Many different theories of origin for the diamonds in the Gold Coast have been put forward, but in view of the occurrence of the stones in areas underlain by metamorphosed Birrimian rocks, their discovery *in situ* in weathered Birrimian greywacke and phyllite, their absence in areas underlain by granite or in granitic rocks and for other more detailed reasons, Dr. Junner believes that the ultimate origin of the diamonds is in Birrimian rocks, which are the oldest known in the Gold Coast.

New Phosphate Fertiliser Process.—The normal method of converting the phosphorus contained in rock phosphate into a form

readily available for plant nutrition is to make it into superphosphate by treatment with sulphuric acid, but various other methods are also employed or have been proposed. Among them are several processes in which the rock phosphate is fused with alkali and alkaline earth silicates, but all these methods involve the use either of large proportions of addition agents, with resultant high fusion costs and low phosphate concentration in the product, or the employment of comparatively expensive materials such as sodium carbonate. A new fusion process, however, which suffers from neither of these disadvantages, has recently been investigated in the United States, and the results were presented in a paper read to the American Chemical Society in September 1942 which has lately been published (Fertiliser by fusion of rock phosphate with olivine, by J. H. Walthall and G. L. Bridger, *Industr. Engng. Chem. (Industr. Edit.)*, July 1943, 774-7).

After preliminary trials involving fusion of rock phosphate with magnesia and silica had shown that a product high in phosphate solubility could be obtained, tests were made with the natural magnesium silicate, olivine, which proved to be equally satisfactory. The procedure is to mix the constituents ground to -4 mesh or finer, fuse the mix in an electric furnace and cool the melt rapidly by quenching in water. A series of trials was made with varying proportions of olivine and it was found possible to convert practically the whole of the phosphorus into the "available" or citrate-soluble form by using 0.62 lb. of olivine per lb. of rock phosphate. The pouring temperature of the melts was 1450° to 1550°C. In order to minimise loss of phosphorus by volatilisation, a direct arc furnace was charged continuously for 8 hours and tapped every 30 minutes, thus ensuring that there was always a layer of unfused charge above the melt. Analyses indicated that the loss of P_2O_5 was only 1 per cent. and the fluorine volatilisation was 11 per cent.

Fusion of a mixture of 1 lb. rock phosphate (33 per cent. P_2O_5 and 3.6 per cent. fluorine) with 0.46 lb. olivine (45 per cent. MgO and 44 per cent. SiO_2) yielded a product containing 22.8 per cent. total P_2O_5 (21.4 per cent. soluble P_2O_5) and 1.9 per cent. fluorine. This fusion product was ground to 100 mesh and subjected to pot culture tests in a greenhouse using standard and concentrated superphosphate and defluorinated fused rock phosphate as controls, and the results showed the olivine fusion product to be practically as effective as either of the two superphosphates. Pointing out the advantages of the process the authors draw attention to the expense of sulphuric acid and of elemental phosphorus normally used, to the availability and cheapness of olivine in the vicinity of the American phosphate deposits, and to the fact that the olivine-phosphate fusion product contains more available phosphorus than does standard superphosphate.

An economic study of the process is to be made in due course; however, it is essentially an electric furnace process, since similar

mixtures calcined to incipient fusion in a rotary kiln, or sintered by mixing with coke and burning, yield products in which only 15 or 20 per cent. of the contained P_2O_5 is citrate soluble.

Salt Production in Northern Rhodesia.—Although Northern Rhodesia depends very largely on imports for her salt requirements, a native salt industry, which existed before British colonists entered the country, is still fairly active in some localities. The state of the industry is usually recorded in the annual reports of the Native Affairs department, but there appears to be no systematic account of the salt occurrences, and the following notes have been collected from many scattered references.

The salt is obtained from what are variously described as salt marshes or salt pans, in some of which salt springs are visible, and as no other source of salt is apparent it is reasonable to infer that it all originates from such springs. Mineral springs are known at several widely separated localities in Northern Rhodesia, and are usually believed to be associated with lines of faulting of the Rift Valley period. Some are hot, but others issue at normal ground temperature, and they vary considerably in composition, some bearing silica, others lime and magnesia, or hydrogen sulphide, and only a small proportion are saline. The origin of the salt may therefore be referred to a late phase of the Rift Valley vulcanicity which gave rise to the widespread salt and soda springs and lakes of Kenya and Tanganyika, and is represented further south in the extinct caldera which forms the Pretoria Salt Pan.

The concentration of salt in the spring waters at the salt pans does not appear to be recorded, but it is presumably low, probably less than that of ocean water, for instance. In the dry season, however, there is considerable evaporation from the surface of the ground watered by the springs, and this process can be aided by digging the soil and leaving it exposed for several weeks. In the latter part of the dry season this salt-impregnated earth is dug up, placed in baskets or earthenware filters, leached with water and the salt recovered by evaporation over fires. The process is very slow, and a family may work for 6 weeks to recover 120 lb. of salt. Another method is to collect certain of the swamp and river grasses and reeds which have a high salt content, burn or carbonize them, and leach the salt from the ash and charcoal, but this type of salt usually has a bitter taste. Formerly small baskets or rounded lumps of salt were a recognised form of currency, and were used as tribute to chiefs; and in the early years of British administration taxes were paid in salt in the producing areas. Even to-day salt, both native and imported, is widely used for trade and barter in outlying districts.

The most important saltmaking district is near the north-eastern shore of Lake Mweru around Chienji. Dr. Livingstone recorded salt-making here in 1867, and more recently it has been described

by R. J. Moore (Industry and trade on the shores of Lake Mweru, *Africa*, Vol. X, 1937). The principal centres are at Kaputa, about 30 miles E.N.E. of Chienji, at Puta, just south of Chienji, and at Ponde and Kalembe. Warm springs issue at all these places, but it is the black earth, often a little further down the valley, which is worked. The earth is dug up about the middle of June and left to dry for three or four weeks, salt extraction then begins and is continued until November. Often 600 or more people camp at the salt pans, the men fetching firewood and digging the earth, the women leaching it and evaporating the brine over fires. In a season a family may make 6 to 20 parcels of salt, each weighing about 50 lb. The district yields about 50 tons of salt in a normal season, which is traded over all the surrounding country, and even reaches Fort Rosebery 175 miles away. There was a very long dry season in 1938, and 120 tons of salt were produced, but much of it remained unsold. The price is about 1d. per lb. at the source, and ½d. to 1d. extra for every hundred miles transport. The industry is the principal source of income in the surrounding villages and appears to be as lucrative as much European employment which is only available much further afield.

Another important centre in North-Eastern Rhodesia is the Chibwa salt marsh 12 miles west of Mpika. The output here is usually about 15 tons per season and may occupy about 200 men. A large part of it is purchased by the Government stations at Mpika, Chinsali and Serenje for issue to employees. The following analysis of this salt by McCance and Widdowson shows a rather high content of sodium sulphate:

Na	K	Ca	Mg (Gm. per 100 gm.)	Fe	Cl	SO ₄	Cu (Mgm. 100 gm.)	Mn
32.50	2.405	0.313	0.038	0.045	45.60	21.30	0.25	0.70

A dietetic study of the Bemba tribe who inhabit the Mpika district has been made by Dr. Audrey I. Richards, and on the question of salt consumption she points out that the local diet includes very little meat and that with a vegetable diet added salt is essential. "Salt is not easily obtained. When available, about a teaspoonful a day would be spared for cooking, but it is not uncommon to find households that have been some weeks without any salt at all, and which have not been able to make good this deficiency by eating meat." . . . "There is a definite craving for salt in all the villages, and salt has been used as an article of trade longer than any other commodity." (*Africa*, Vol. IX, 1936, p. 186, and *Land Labour and Diet in Northern Rhodesia*, Oxford University Press, 1939.) In passing, it may be noted that in Tanganyika Territory, but only 50 miles from the Rhodesian border, salt springs feeding a small lake at Ivuna near Lake Rukwa are worked by a European firm.

The Kaimbwe salt pan, 30 miles N.N.E. of Kasempa in North-Western Rhodesia, is worked by natives from the Kasempa and

Mwinilunga districts, and the salt is sold as far afield as Mankoya, 140 miles away. On the map the pan is shown as a hot spring. The District Commissioner has tried to induce the Native Authorities to organise expeditions to the pans from a greater number of villages in order to increase the local consumption of salt as part of the everyday diet. A little of this salt has been sold as cattle lick. Further south in the Namwala district salt has been obtained from hot springs near the Kafue River a few miles from Nkala Mission. Several saline springs occur along the Zambezi between Livingstone and Feira, and salt has been extracted at the Kapesa (or Chatenta) spring near the Kariba Gorge, and at the Chilambwa spring near the Chezia river 40 miles south east of Monze.

The total production of salt is obviously small, but until the standard of living is much higher it will continue to be a valuable local asset. The survival of the industry is probably due to the remoteness of the producing centres, which are from 200 to 350 miles from the railway, to the lack of native cash crops for export, and to the encouragement of the local Government officials. During the forty years in which the Colony has been developing, the imports of salt have increased from year to year, exceeding 500 tons by 1920, 1,000 tons in 1926, and 2,000 tons in 1938, but it is clearly desirable that the salt consumption of a population numbering 1,400,000 and of more than 600,000 head of cattle should increase much further.

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BULLETIN OF THE IMPERIAL INSTITUTE

VOL. XLI. NO. 4.

OCTOBER-DECEMBER, 1943

PLANT AND ANIMAL PRODUCTS

REPORTS OF RECENT INVESTIGATIONS AT THE IMPERIAL INSTITUTE

Selected from the Reports made to the Dominion, Indian and Colonial Governments

CASTOR OIL FROM NIGERIA AS A LUBRICANT

IN view of the shortage of mineral oil, the possibility of using castor oil for lubricating purposes has been considered in several Empire countries where castor seed is or can be grown. Considerable success has been reached in this direction in Nigeria, where, according to the Annual Report of the Agricultural Department for 1942, the Nigerian Railway is now using the oil as a lubricant for locomotives. An experimental consignment of 1,000 gallons of the oil was extracted locally, the greater part of which went to the Railway, which found it quite suitable for lubricating crossheads and motions of locomotives. Tests were also carried out by the Agricultural Department and the Public Works Department on Chevrolet kit cars and the oil was found satisfactory for use in the gear box. Pure castor oil, however, proved to be unsuitable as a lubricant for internal combustion engines owing to the rapidity with which it becomes gummy.

Further development now awaits the provision of a small power-operated plant for extracting the oil. In the meantime the 1942 crop of Nigerian castor seed was purchased by the Ministry of Supply.

The Imperial Institute has assisted in this work by examining samples of seed and oil produced in Nigeria, and the two most recent reports which were submitted to the Government are dealt with below.

I. SAMPLES OF SEED

Four samples of castor seed were forwarded by the Director of Agriculture in June 1942. They were as follows :

Sample A. Large, greyish-brown castor seeds mottled with brown.

Sample B. Castor seeds which varied in size from small to large, but which were mostly of medium size. They were rather mixed in colour, varying from greyish with brown mottlings to chocolate with greyish-brown mottlings.

Sample C. Small castor seeds which were mostly very dark brown in colour with greyish-brown mottlings.

Sample D. Very small castor seeds, greyish-brown in colour with dark brown mottlings.

The seeds were examined with the results given in the table below :

	A.	B.	C.	D.
Weight of 100 seeds in gms.	54.5	38.9	18.1	9.2
Moisture per cent.	6.7	6.5	5.8	6.7
Oil in seeds, as received	45.2	45.9	48.0	41.5
Oil, expressed on moisture-free seeds per cent.	48.4	49.1	51.0	44.5
Acid value of extracted oil : mgms. KOH per gm. of oil	6.3	3.2	5.1	4.0
Equivalent to free fatty acids, expressed as oleic acid per cent.	3.17	1.61	2.56	2.01

Castor seed of commerce usually contains from 46 to 53 per cent. of oil. It will therefore be seen that with the exception of Sample C the oil content is low, particularly in the case of Sample D.

With the exception of Sample B the acidity of the extracted oils is higher than desirable. Even the oil from Sample B has a greater free fatty acid content than the maximum figure of 1 per cent. which is deemed by some manufacturers to be the limit. The high acidity is probably due to the seed being old or having been stored unsuitably.

In spite of the above comment on the oil content, castor seed as represented by the samples should be suitable for the preparation of an oil which could be used as a lubricant, but it is important that steps should be taken to ensure that the seed is not allowed to deteriorate through age or unsuitable storage before being crushed.

It was not possible to ascertain from an analysis of the samples of seed whether there is any difference between the lubricating properties of the oils prepared from them. The existence of any such differences would be best determined by the examination of oils obtained by crushing the seed in Nigeria. Oils prepared from the seed by extraction with a solvent on a laboratory scale would not necessarily be identical with the oils yielded on crushing on a commercial scale.

II. SAMPLE OF OIL

At the suggestion of the Imperial Institute, a sample of castor oil, stated to be representative of the oil now being produced in Nigeria, was forwarded by the Director of Agriculture in January 1943, in order to investigate its value as a lubricant.

The sample consisted of 1½ pints of a clear, pale golden-yellow, viscous oil, free from sediment and other insoluble matter.

It was examined with the following results, which are shown in comparison with those obtained at the Imperial Institute for a previous sample of castor oil from Nigeria reported on in January 1942, and with the requirements of the Air Ministry General Specification (D.T.D.71) for Castor Oil for Lubrication and of the British Standard Specification, No. 650-1936, for Castor Oil ("Firsts" Quality).

Property.	Present Sample.	Previous Sample.	Air Ministry Specification (D.T.D.71.)	British Standard Specification 650/1938.
<i>Clarity</i>				
<i>Colour</i> : (Lovibond : 1 in. cell)	Clear	Cloudy	Clear	Clear
Yellow units	6.2	15.0	Not more than slightly coloured	Not deeper than 2.2
Red units	1.5	4.5		Not deeper than 0.25
<i>Specific gravity</i>				
15.5/15.5° C.	0.9645	0.964	0.959-0.968	0.958-0.959
<i>Critical solution temperature in alcohol</i>	Below 0° C.	+2° C.	Below 0° C.	Below 0° C.
<i>Unsaponifiable matter per cent.</i>				
B.S.S. method	0.7	0.7	—	Not more than 1
Air Ministry method	0.9	—	Not more than 0.8	—
<i>Viscosity, 200° F.</i>				
Redwood, secs.	100.8	98.5	Not less than 93	—
Centipoises	23.6	23.0	Not less than 20	—
<i>Free acidity</i>				
mgms. KOH per gm. oil	1.8	5.1	—	Not more than 4
Expressed as oleic acid per cent.	0.90	2.6	Not more than 1.75	Not more than 2
<i>Cold test</i>				
B.S.S. method	Clear at 0° C.	Clear at 0° C.	—	Clear at 0° C.
Air Ministry method	Clear at -10° C.	Not clear at -10° C.	Clear at -10° C.	—
<i>Iodine value per cent.</i>	85.1	82.6	82-89	82-90
<i>Acetyl value</i>	145.0	—	—	Not lower than 144
<i>Refractive index at 20° C.</i>	1.4792	—	—	1.477-1.481
<i>Saponification value</i>	180.6	—	—	177-187

The present sample of castor oil is of good quality and is a much better product than the previous sample examined. It fulfils the requirements of the Air Ministry Specification except for a very slightly higher content of unsaponifiable matter, but this slight difference is not of any practical significance. Except in regard to colour the oil meets the requirements of the British Standard Specification ; this specification, however, is for "Firsts" Quality Castor Oil as to which no claim is made for the present sample. It is satisfactory to note that the free acidity of the present sample falls below the maxima of the two specifications and in this respect particularly is an improvement on the earlier sample.

The sample was submitted to Messrs. C. C. Wakefield & Co., Ltd., the well-known firm of lubricating oil manufacturers, whose Chief Chemist has reported as under :

"I feel that I can usefully commence by offering my congratulations to the Agricultural Department, Nigeria, on the production of such a good sample of castor oil. I feel confident that this oil should give similar results when used as a lubricant, to the castor oils which have been used for this purpose in the past. It will, of course, be understood by those who use this castor oil, that there are differences in behaviour between mineral lubricating oils and castor oil, consequently if a change is made from mineral oil to castor oil, different results may be expected. For some purposes pure castor oil is superior to mineral oil, but for other applications it is inferior. I mention these things because I feel that the new venture of producing castor oil locally may receive a setback from the users, merely because its uses have not been properly understood.

"I have referred to the limitations of castor oil as a lubricant, the chief difficulty being its tendency to form gummy deposits and to become acid in use. If it is used in internal combustion engines, it will be found that greater attention will have to be given to keeping the piston rings free from a deposit ; if not, they may become completely stuck in their grooves. When this occurs, scoring of the piston or liner may occur. If the castor oil is used in gear boxes, it is important that the temperature should not exceed 83° C. Above this temperature there is probably a tendency to acid development, increase in viscosity and possibly gummy deposits ; all of which can be clearly accelerated by the presence of iron or copper oxide."

The present sample of castor oil is of good quality and should give similar results, when used as a lubricant, to the castor oils already employed for this purpose.

MEXICAN POPPY SEED (*ARGEMONE MEXICANA*)
FROM NIGERIA

IN June 1943 a sample of Mexican poppy seed (*Argemone mexicana*) was sent to the Imperial Institute by the Department of Agriculture, Nigeria, for report on its commercial value with special reference to the suitability of the contained oil for use in the paint and varnish industries.

The sample weighed $3\frac{1}{2}$ lb. and consisted of small, dark brown, spherical seeds. It was examined with the following results, which are shown in comparison with those obtained for Mexican poppy seed from South Africa previously examined at the Imperial Institute.

	Present Sample. Per cent.	Previous Sample from South Africa. Per cent.
Moisture in seed as received	9.2	7.7
Oil in seed as received	34.5	36.5
Oil expressed on moisture-free seed	38.0	39.5

The oil as extracted from the seed with light petroleum was a limpid, golden-yellow oil with a slight nutty odour. A very small amount of stearines were deposited on standing.

	Present Sample.	Previous Sample from South Africa.
Specific gravity at $15/15^{\circ}$ C.	0.9247	0.9220
Refractive index at 20° C.	1.4742	1.466
Acid value	10.3	21.6
Saponification value	192.1	192.7
Iodine value [Wijs, $\frac{1}{2}$ hr.] per cent.	119.1	123.7
Unsaponifiable matter	1.6	1.14
Colour (Lovibond : 1 in. cell)		
Red units	2.0	—
Yellow units	40.0	—

The results of the examination show that the present sample of Mexican poppy seed from Nigeria resembles closely the previous one from South Africa both as regards the oil content and the character of the extracted oil.

Mexican poppy seed oil has very inferior drying properties when used either alone or mixed with driers. It is not suitable for use alone as the oil vehicle in paints and varnishes. In normal times its use in these industries would not be considered, but in present war conditions with a shortage of paint oils it seems possible that it might be found practicable to blend it in small proportions with linseed oil thereby effecting a saving in the amount of the latter employed. Practical trials would be necessary to determine this point. Such tests would indicate the maximum proportion of Mexican poppy seed oil that can be added to linseed oil to produce a mixture still retaining satisfactory drying properties.

Even if these trials showed that appreciable quantities of Mexican poppy seed oil could be successfully mixed with linseed oil to yield a satisfactory drying oil, the import of the seed into the United

Kingdom for crushing might not be considered economic owing to the fact that the oil-cake, on account of its deleterious properties, cannot be used as a feeding stuff for animals but is only suitable for use as a fertiliser.

In these circumstances the Ministry of Supply have been consulted as to the desirability of carrying out practical trials with the oil. The reply received is to the effect that in view of the present linseed oil situation, the character of the oil-cake, and the doubtful value of the oil in varnishes, extensive work on the subject is not warranted.

ARTICLE

EAST AFRICAN HIDES AND THE POST WAR MARKET: ELIMINATION OF GOUGING DAMAGE

By J. R. FURLONG, Ph.D., A.I.C.,
Secretary, Imperial Institute Consultative Committee on Hides and Skins

At the end of the last war fair quantities of East African cattle hides were being used in the United Kingdom, but they were liable to be poor in quality, and the trade gradually fell away to small proportions. The Continental trade in the meantime increased, and finally constituted the principal outlet for East Africans.

The main drawback to the hides was the unsatisfactory curing, the native method of sun-drying giving rise to "taint" and "blister," putrefactive damage which reduced the value of the hide to a varying degree. Efforts were made by the veterinary departments in East Africa to introduce shade-drying where local conditions were suitable. Hide-drying bandas were erected in the chief cattle areas, and instruction given on correct methods of preparation. Legislation covering the control of markets was introduced. In 1932 a comprehensive scheme for investigating the causes of blister, drawn up by the Imperial Institute Consultative Committee on Hides and Skins, was carried out in Kenya. The hides (numbering 1,000) from the experiments were shipped to England and submitted to tanning trials. The Committee's report, "The Drying of East African Hides" (see this BULLETIN, 1934, 32, 41), showed that the essential fact in preventing putrefaction was the provision of free circulation of air on both sides of the hide during drying. The lines on which drying should be carried out were laid down by the Committee in the report. This suspension method of drying, either in the sun or shade, as contrasted with the native method of pegging the hide on the ground, yields a hide of excellent cure, and has been widely adopted.

As a result of this work and the active steps taken by the authorities in East Africa considerable progress has been made of late years in drying, and the quality of the cure of exported East African hides has greatly improved. This was the position when the present world war upset the marketing channels which had come into being. The first effect was to close down East Africa's principal hide market on the Continent. The next and present set of conditions has put into the hands of United Kingdom tanners, who had discontinued their use, increasing quantities of East African hides. The extent of the improvement effected in the interval of disuse is witnessed by the following statement from Mr. R. Withinshaw, of the Penketh Tanning Co., who recently received consignments. "It may interest you to know that we have not had many of these hides during the last years, as previously they were badly cured giving a large percentage of damaged hides. We think it only fair to say here that the improvement in the soundness of these hides is enormous, and we would like to congratulate all those responsible for the excellent improvement they have achieved in this direction. Throughout the two consignments the drying of the hides, almost without exception, was perfect, one or two only had very slight putrefaction."

There is, however, another fault to which East African hides have been subject at times, and which has recurred recently in hides from one area. It consists of cuts or gouges more or less deep, caused in the operation of cleaning the flesh side subsequent to flaying. In view of the progress made in drying, it is disappointing to find that the good cure may be vitiated by gouging damage, and the object of this article is to emphasise the need of eliminating this fault, for the following reason. English tanners through the force of circumstances are again using East African hides, and are finding them superior in cure to the badly dried ones of their previous experience. This market for East Africans represents a better one than the pre-war Continental trade, and it would be good policy to strive to retain the English market after the war. To do this the liability of East Africans to gouging damage must be stopped.

The Committee has previously directed attention to gouging damage, and encouraged steps for its elimination. In the report on the Kenya drying experiments, referred to above, the occurrence of permanent knife damage on some of the "cleaned" hides was noticed, and the recommendation made that the operation of cleaning the hides should be discontinued. The subject was again to the fore in 1938 when a firm of tanners in the United Kingdom complained of the seriousness of the damage in consignments at that time. On this occasion and whenever the Committee made recommendations with regard to the preparation of hides the advisability has been urged of stopping the practice of the after-cleaning of hides.

The occurrence of the damage is thus well known, but the veterinary departments concerned have not been unanimous in

accepting the view that the fault arose in the after-cleaning, and opinion has been expressed that it was a flaying error. The Committee, however, while recognising the existence of flaying damage in some instances, has satisfied itself that the bulk of the gouging of which it complains is caused in the after-cleaning operation.

The damage consists in general of more or less deep cuts or gougings on the flesh side of the hide, often penetrating through the hide to the grain side. In the two recent consignments which have again brought this feature to notice, the injury was of three different kinds, some hides showing all three while others showed one or two. The three kinds of gouging were as follows :

- (1) Long continuous furrows parallel to the back bone.
- (2) Irregular gougings, some very deep, in various directions.
- (3) A fairly regular pattern of short, slightly curved gougings close together, across the hide.

The two consignments in question were received by the Penketh Tanning Co., and attention was drawn to the gouging damage by Mr. R. Withinshaw, who represents that firm on the Committee.

Both consignments were described as "Shade Dried Mombasa or Dar es Salaam Butcher Hides," and the evidence obtained from the adhesive labels on the hides indicated that the present occurrence of gouging damage was confined to one limited area of Tanganyika. Nevertheless, it is considered desirable to draw general attention to the serious damage that can be effected on otherwise good hides by this fault.

The accompanying photographs (Plates X-XIII) illustrate the nature of the damage. They are photographs of the flesh side of the finished leather made by the Penketh Tanning Co., and it may be noted that the process of manufacture tends to render the injury less noticeable, in addition to which the damage is not so strikingly apparent in a photograph as in the actual leather. One photograph (Plate XIV) represents leather from a well-prepared hide. It shows the natural veins but is free from gouging damage, and is included for comparison. The photographs were made by Mr. H. J. Broughton of the Imperial Institute and show the damage at three-quarters natural size.

An investigation was made of the two consignments in which gouging was observed, and it was found that the hides on which the injury occurred were flat, stretched, very clean and light coloured on the flesh side, while those hides which were free from damage or only slightly gouged were not so flat, and had dark or blood-stained flesh. Many of the hides were gouged over the entire flesh surface.

Careful examination of the damage leads to the conclusion that it has been caused in the operation of removing superfluous fat and flesh, subsequent to flaying. It is apparent that in an attempt to produce a very clean flesh side a knife or other sharp instrument has been carelessly used. We have been informed of many different

PLATE X.

EAST AFRICAN HIDES.



Flesh side of finished leather showing gouging.

PLATE XI.

EAST AFRICAN HIDES.



Flesh side of finished leather showing gouging.

PLATE XII.

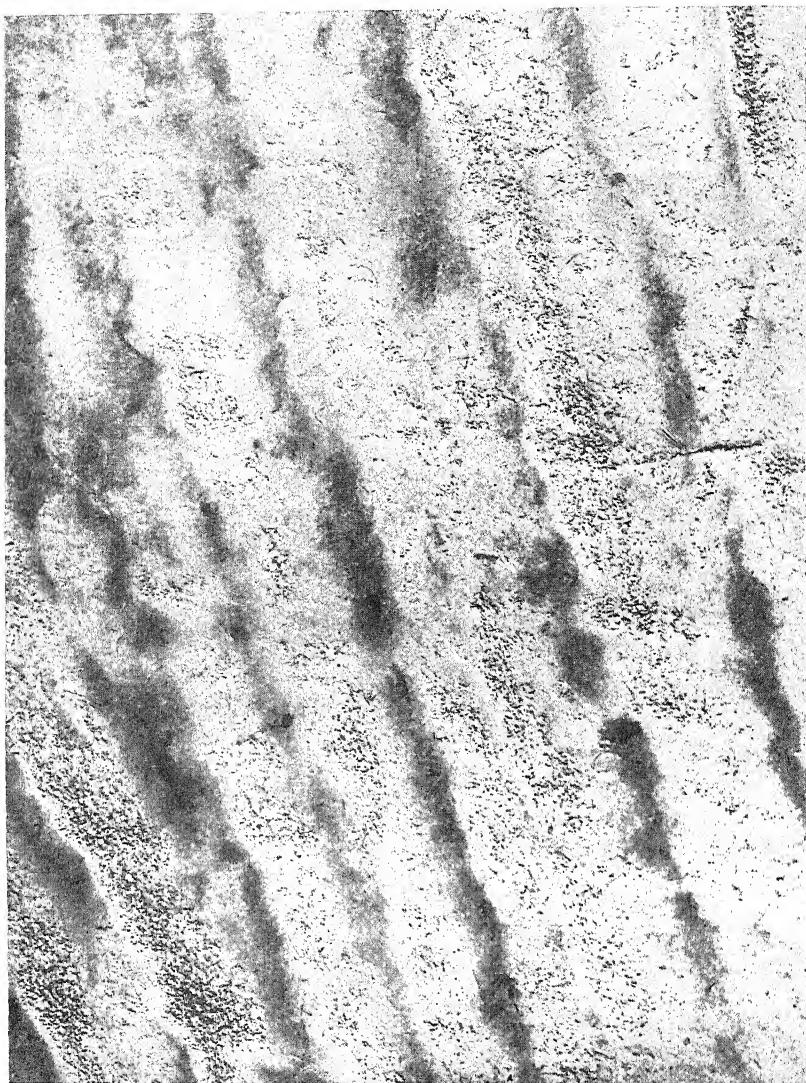
EAST AFRICAN HIDES.



Flesh side of finished leather showing gouging.

PLATE XIII.

EAST AFRICAN HIDES.



Flesh side of finished leather showing gouging.

PLATE XIV.

UNDAMAGED HIDE.



Flesh side of finished leather free from gouging.

implements pressed into service for this purpose, including an actual carpenter's gouge.

The removal of the superfluous material is unnecessary, as adherent fat and flesh are not detrimental to the quality of the hide, and present no difficulty when the hides are worked in the tannery. Tanners have repeatedly stated that they have no objection to hides in that condition. Whatever small advantage there is in a perfectly clean flesh surface they are prepared to forego in order that the risk of cutting may be eliminated. The damage once it occurs is permanent, and if severe, as is often the case, ruins the hide for the best class work for which it would otherwise be suitable, and renders it of use only for inferior purposes with a very considerable loss of value.

Since the experience of the past years has shown that careless and extravagant use of the knife is always liable to recur, it is not advisable to encourage any cleaning of the hide by knife or similar implement, as the risk of careless treatment would remain. Consequently the Committee has strongly recommended the authorities in East Africa to take immediate steps to stop the practice, where it exists, of removing superfluous fat and flesh from the hide. Good flaying is desirable, but no increase in the use of the knife should be allowed in this operation in place of fleshing.

When trouble of this kind comes to light it is most important to trace the origin of the hides, so that appropriate action can be taken in the area concerned to prevent a recurrence of the trouble. This at once raises the vital question of the proper marking of hides and skins with a permanent identification mark. In the two consignments in which gouging damage recently occurred the hides had only adhesive paper labels, some of which were totally destroyed and some were illegible. It was only possible with great difficulty to read the writing, where it remained. The small number with printed labels were less troublesome. In 1936 the Committee recommended the marking of hides with a three letter brand denoting country and district of origin and mode of drying. (See this BULLETIN, 1937, 35, 74, and 1938, 36, 360.) In the present case this permanent marking, if it had been present, would have enabled the district where the damage originated to have been identified with greater ease.

To sum up, East African hides of excellent cure are now available, but it is necessary to eliminate the chance of gouging damage occurring, in order that these hides may build up a good reputation and strong position in the United Kingdom tanneries, under the present favourable opportunity. To enable them to maintain that position against post-war competition the quality of these hides must be raised to the best possible level.

NOTES

Rubber in Nigeria.—The following report on research work recently carried out by the Forest Department on the production of rubber in Nigeria has been kindly furnished to the Imperial Institute by the Chief Conservator of Forests.

Great effort has been made to resuscitate in Nigeria an industry long dead. With regard to *Funtumia* rubber the results have been highly successful, but we have so far failed to produce anything approaching the potential of vine rubber. A close study has been made of the many problems involved—frequency, latex yield, tapping methods, processing and the economics of production as far as was possible in a relatively short period and with limited staff.

In 1942 research was extensive and exploratory rather than intensive. All possible sources of rubber, including the "flake" and "paste" of low caoutchouc content, were sought; many hundreds of specimens were examined and a large variety of latices were analysed. Exploitation of low grade rubber is now restricted and effort and research are directed to obtaining the maximum production of *Funtumia*, Ceara and high-grade vine rubbers.

Funtumia is mainly concentrated in the high forest region of the Western Provinces, from which about 1,000 tons of rubber was produced in 1942. A close survey indicates that nearly all the available trees were exploited. It had been hoped that a still higher yield would be obtained in 1943 by more intensive tapping but it has been shown that the dry rubber yield on second tapping after about 10 months interval is only half that of first tapping, and trees tapped twice in 1942 now yield less than a quarter of the original yield. *Funtumia* rubber production in 1943 is therefore unlikely to exceed half the 1942 production.

Vine rubber presents far more complex problems. Although *Landolphia owariensis* (including several "varieties") is the predominant species throughout most of Nigeria, in the Cross River Cameroons high forest region, which apart from Igala Division of Kabba Province is by far the more important vine rubber region, we have a considerable number of different species to deal with, greatly varying in latex yields and requiring different means of processing. The varied technique has been carefully worked out, the potentialities explored. Vine frequency in this region varied from 0.2 to 3.6 per acre. Average latex yields vary between 0.5 lb. and 2.5 lb. per vine according to species. The dry rubber/latex ratio also varies with species but averages about 30 per cent. Rubber yield per square mile varies from about 50 lb. in the poorest to 400 lb. in the richest areas; frequency and distribution of species is most variable. The climbing and cutting of vines is most arduous and dangerous work, and even the most skilled tapper in good vine forest cannot prepare more than 17 lb. of rubber in a month. Labour, let alone skilled tappers, is very scarce in this region and is one of the greatest problems, but given fair remuneration the

vine rubber will be produced ; but fair remuneration demands a very much higher price for vine rubber than for *Funtumia* and higher for *Funtumia* than for Para.

Linen Flax in Australia and New Zealand.—Before the war the United Kingdom grew rather less than a tenth of its linen flax requirements, and some 60,000 to 70,000 tons were imported annually. At the same time Empire production of the fibre as a whole was only in the neighbourhood of one per cent. of the world's output, leaving the United Kingdom, with its important linen industry, very largely dependent on foreign production for the raw material. The world's flax fibre crop is normally grown in the Soviet Union, and in Northern and Western European countries. War needs made it necessary to replace sources of supply no longer available, and the acreage grown in this country has been expanded very materially. Canada has developed considerably what was a small pre-war production, Kenya has once again built up a useful growing industry, and there has also been some Indian interest in the crop. Both Australia and New Zealand have made very important contributions to war-time supplies. Much has been written regarding the crop in these Dominions, and progress has been described recently. An article entitled "Flax Production in Australia," by Christopher Haven, has been published in the Australian geographical magazine, *Walkabout*, and is summarised in the *Linen Trade Circular*, June 5 and 26, 1943 ; while "The Saga of Linen Flax," by J. H. Claridge, appears in the *New Zealand Journal of Agriculture*, March 15, 1943, pages 133-135.

In Australia expansion of flax growing has been undertaken by the Flax Production Committee set up by the Department of Supply and Development when the Commonwealth Government took control of the industry in 1940. Linen flax was not an entirely new crop in Australia and experience had been gained from the small flax growing industry that was already established, chiefly in Victoria. From 200 acres in 1936 rather less than 2,000 acres were grown in 1939. By 1941 some 56,000 acres were planted and some 72,000 acres were planned for 1942. At the present time Australia is meeting her own domestic requirements for linen flax and is supplying the United Kingdom with the fibre grown on some 50,000 acres. It is suggested that in peace-time the area grown may be reduced to the neighbourhood of 20,000 acres, to supply Australian domestic requirements of about 2,000 tons of fibre a year, unless it is possible to reduce the costs of production to an extent that would permit export in competition with the European peasant growers.

Liral Crown, the variety introduced by the Linen Industry Research Association, Lambeg, Northern Ireland, is now almost exclusively grown in Australia. It has been found to give a higher yield of straw per acre, and a higher outturn of fibre per ton of straw than other varieties.

The crop is reported to succeed on a wide range of soils but does best on fertile loams or clay loams. A cool moist climate without dry spells during the growing season is most desirable. In New Zealand October, November and December have been described as the critical months. Insufficient moisture at this time is said to lead invariably to stunted crops which in most cases cannot be harvested for fibre.

In Australia a rainfall of at least 23 to 25 in. depending upon the distribution is required. The crop is drilled in winter, early sowing seems to be preferable, and is grown much in the same way as a crop of oats. In some circumstances two crops in succession may be taken. In Australia linen flax is cut with the binder, it is not pulled as in other countries. The straw is first de-seeded and is then retted in specially heated tanks at the mills. Dew retting has also been employed. According to one account Australian yields have ranged from 25 cwt. to 3 tons of flax straw per acre. It appears than an average return may be in the neighbourhood of 35 cwt. flax straw per acre.

In New Zealand progress has been no less spectacular. Before the war linen flax was confined to small trial plots; in 1943 1,000 farmers were growing 23,000 acres of the crop. By the same year 17 processing factories had been established, 250 pulling machines obtained, and 200 tons of linen flax were being forwarded monthly to the spinning mills in the United Kingdom.

What has been achieved in these Dominions reflects great credit on all concerned: on the authorities, farmers, technical staffs, and all workers who have taken part in the development of linen flax. The necessary acreages have had to be found and cultivated, machinery has been provided, and the processing factories have been built and equipped at short notice. Costs have doubtless been high, but a new vital war-time agricultural production has been established on an appreciable scale in what is a very short time. Rapid expansion in the commercial production of what is in effect a new crop is rarely an easy matter in any area, that greater difficulties were not encountered in these countries is perhaps the best testimony to the efforts of all concerned.

Butter-fat Content of "Black" Cacao.—The disease of cacao known as "Black Pod" is caused by a strain of the fungus *Phytophthora palmivora* Butler, other strains of which attack the coconut palm, Hevea rubber and other important tropical crops. The continuously humid, hot climate of the cacao growing region of West Africa greatly favours the development of this disease, which is of widespread occurrence in the Gold Coast and Nigeria. One result of the disease is that the beans in infected pods eventually turn black.

The question whether the disease affects the fat content of this "Black" cacao and the free fatty acid content of the fat, has

recently been investigated by Mr. J. West, Botanist, Department of Agriculture, Nigeria, in conjunction with the Chemical Section of the Department. The Acting Director of Agriculture has kindly furnished to the Imperial Institute a copy of Mr. West's report on the experiment, the substance of which is given below.

Experiment I was designed to find the butter-fat content in good and "Black" beans. Healthy and diseased pods were taken from individual trees in the experimental area known as Agodi Ten Acres so as to avoid variations between trees. The wet beans were tied up in muslin bags which were buried in a heap of wet cacao and fermented for four days. Each sample was then dried and handed to the Chemical Section for analysis. The results are shown in the following table :

TABLE I

Samples.	Butter Fat on Oven Dry Matter.				
	Per cent.				
Ia 1 good ripe pod	55.23
Ib 1 dead unripe pod	57.18
IIa 1 good ripe pod	51.75
IIb 1 $\frac{1}{4}$ -dead ripe pod	54.99
IIIa 1 good ripe pod	56.04
IIIb 1 dead unripe pod	58.50
IVa 2 good ripe pods	55.13
IVb 2 dead ripe pods	58.48
Va 1 good ripe pod	56.07
Vb 1 half-dead ripe pod	58.51

Pods harvested 18-11-42. "a" denotes beans from healthy pods and "b" from diseased pods.

It will be seen that in every case the butter-fat content of beans from diseased pods was higher than that of beans from healthy pods taken from the same tree. This suggests, Mr. West points out, that the Black Pod fungus attacks the tissues of the beans but not the butter fat.

Experiment II was concerned with the F.F.A. of the butter-fat in diseased beans. Random samples of beans from healthy and dead pods were fermented in muslin bags as in the previous experiment. Again the butter-fat content of the diseased beans was higher than that for healthy beans and there was no difference in the F.F.A. of the butter-fat in the two samples. The actual figures are given in Table II.

TABLE II

Sample.	Butter Fat. Per cent.	F.F.A. as Oleic Acid. Per cent.
Healthy Beans	50.20	2.0
Diseased Beans.	51.55	2.0
Pods harvested 12-5-43.		

The butter-fat content in Experiment II was lower than in Experiment I because the beans were from light crop cacao.

Mr. West points out that the results of these preliminary experiments are particularly interesting in view of the fact that before

the war the Germans were allowed to export a special grade of "Black Cacao" from their plantations in the British Cameroons. Presumably they were interested in the beans as a source of edible fat and not of chocolate.

This assumption of Mr. West seems to be borne out by the fact that it is known that just before the war the Germans were developing methods of preparing butter-fat by extraction from damaged beans such as those affected by sea-water or which had become mouldy through bad storage conditions.

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The Nutrition of the Bacon Pig. The Lehmann Method of Pig Feeding, with Particular Reference to the Balance of the Basal Meal and the Use of Cooked Potatoes and Molassed Beet Pulp as the Supplemental Foods. By H. E. Woodman and R. E. Evans. *J. Agric. Sci.*, 1943, 33, Part 3, 155-168.

War-Time Poultry Feeding. By E. T. Halnan. *Growmore Bull.* No. 5 (1943 Ed.), *Minist. Agric.* Pp. 8, 9½ × 6. (London: H.M. Stationery Office, 1943.) Price 3d.

Dried Egg. Part I. The Preparation, Examination and Storage of Spray-dried Whole Egg. By E. C. Bate-Smith, J. Brooks and J. R. Hawthorne. *J. Soc. Chem. Ind., Lond.*, 1943, 62, No. 7, 97-100.

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The Use of Fluorides in the Preservation and Disinfection of Hides and Skins. By M. E. Robertson and E. W. Merry. *Leath. Wld.*, 1943, 35, No. 1705, 598-599.

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FORESTRY

General

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Annual Report of the Forest Department, British Honduras, for 1942. Pp. 8, 9 × 7½. (Belize: Government Printer, 1943.)

Annual Report of the Department of Lands and Mines, Alberta, for the year ended March 31, 1942. Pp. 106, 9½ × 6. (Edmonton: King's Printer, 1943.) Contains the reports of the Director of Forestry and of the Fish and Game Commissioner.

Report of the Forest Department, Mauritius, for 1941. Pp. 6, 9½ × 6. (Port Louis: Government Printer, 1942.) Price 10 cents.

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Report on the Forest Department, Nigeria, for 1942. Pp. 21, 9½ × 7. (Ibadan: Government Printer, 1943.)

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The Seeding of *Anogeissus latifolia*. By J. Prasad. *Indian For.*, 1943, 69, No. 5, 193-196.

Raising of New *Chil* (*Pinus longifolia*) Crops. By F. M. Khan. *Indian For.*, 1943, 69, No. 5, 201-204.

The Identification of Powdered Wood Charcoals. By L. G. G. Warne. *J. Soc. Chem. Ind., Lond.*, 1943, 62, No. 9, 141-144.

Timber

A New Method of Wood Evaluation. By C. H. Keepers. *Paper Tr. J.*, 1943, 117, No. 9, 23-27.

The Moisture Content of Timber in Relation to Attack by *Lyctus* Powder-Post Beetles. By E. A. Parkin. *Ann. Appl. Biol.*, 1943, 30, No. 2, 136-142.

Preliminary Studies on Improved Wood. Part I. A Study of the Impregnation of Wood with Resins. By D. Narayananamurti and Kartar Singh. *Indian For. Leaflet*. No. 42 (*Utiliz.*), *For. Res. Inst.* Pp. 15, 8½ x 5¼. (Dehra Dun, U.P.: Forest Research Institute, 1943.) Price As. 6.

Improved Wood. By D. Narayananamurti. *Indian For.*, 1943, 69, No. 8, 314-322.

The Production of a Structural Board by Gelatinisation of Wood Wastes. By S. Coppick and E. C. Jahn. *Paper Tr. J.*, 1943, 117, No. 3, 23-25.

Gums and Resins

Copaiba and Copaiba Oil. By E. Guenther. *Soap*, 1943, 19, No. 8, 25-27, 69-70.

What Every Lac Cultivator Ought To Know. By P. S. Negi. *Bull. No. 49, Indian Lac Res. Inst.* Pp. 11, 9½ x 7½. (Namkum, Bihar: Indian Lac Research Institute, 1942.) Price As. 4.

Shellac. Its Uses in Modern Industry and in War-time. By A. J. Gibson. *Chem. and Indust. Lond.*, 1943, 62, No. 37, 346-348.

Artificial Control of the Enemies of Lac Insects and Lac. Part I. Water-immersion. By P. S. Negi. *Bull. No. 50, Indian Lac Res. Inst.* Pp. 7, 9½ x 7½. (Namkum, Bihar: Indian Lac Research Institute, 1942.) Price As. 4.

Goma de angico. By J. L. Rangel. *Rev. Quim. Industr., Brazil*, 1943, 12, No. 132, 16-17. Describes the collection, preparation and uses of angico resin (*Piptadenia* spp.).

Xanthorrhoea Resin. *Papers from Australia* No. 347, *Aust. Sci. Res. Liaison, Lond.* Pp. 6, 13 x 8. Mimeographed.

Tanning Materials

Natural Tanning Materials of the South-eastern United States. IV. The Trees of the Coastal Plain. By A. Russell and others. *J. Amer. Leath. Chem. Assoc.*, 1943, 38, No. 7, 235-238.

The Quebracho Extract Industry, its Importance in Argentina and Paraguay. *Leath. Tr. Rev.*, 1943, 76, No. 2991, 837-840.

IMPERIAL INSTITUTE

CONSULTATIVE COMMITTEE ON INSECTICIDE
MATERIALS OF VEGETABLE ORIGINQUARTERLY BIBLIOGRAPHY ON INSECTICIDE
MATERIALS OF VEGETABLE ORIGIN, NO. 24

Prepared in collaboration with the Imperial Institute of Entomology and the Department of Insecticides and Fungicides, Rothamsted Experimental Station.

(July to September 1943)

GENERAL

Control of Aphids and Diamond-Back Moth Larvae on Collards with Rotenone-Nicotine Dusts. By H. G. Walker and L. D. Anderson. *J. Econ. Ent.*, 1943, **36**, No. 2, 343-344.

Pea Aphid Control in Eastern Virginia in 1942. By H. G. Walker and L. D. Anderson. *J. Econ. Ent.*, 1943, **36**, No. 2, 281-285. Nicotine and rotenone-bearing dusts tested.

Annual Report of the Council for Scientific and Industrial Research, Australia, for the year ended June 30, 1942. P. 12 refers to the experimental production of pyrethrum; p. 18 records progress made in the development of pyrethrum sprays for army use in which water is the diluent instead of kerosene; pp. 19-20 discusses work on the control of the red-legged earth mite, for which the most satisfactory dusts were proprietary nicotine and nicotine-creosote mixtures and the most promising spray a white oil-nicotine sulphate emulsion.

Report of the Entomological Society, Ontario, 1942. Refers to the treatment of ships' cargo space with pyrethrum-kerosene sprays to deal with insect infestation; also to value of rotenone preparations against lice and scabies.

The Cabbage Butterfly (*Pieris rapae* L.). A Recently Introduced Pest [in Australia]. By C. F. H. Jenkins. *J. Dep. Agric. W. Aust.*, 1943, **20**, No. 1, 35-40. Derris or nicotine dusts or sprays recommended for control.

Roach Control. A Study of the relative Efficiency of various commonly used Insecticide Dusts against Roaches. By H. Landini and H. L. Sweetman. *Soap*, 1941, **17**, No. 6, 129-131, 133, 135. (*R. A. E.*, 1943, **31**, B, Pt. 7, 135.) Pyrethrum and rotenone among the compounds tested.

Experiments on the Poisoning of Honeybees by Insecticidal and Fungicidal Sprays used in Orchards. By C. G. Butler, D. J. Finney and P. Schiele. *Ann. App. Biol.*, 1943, **30**, No. 2, 143-150. Among the substances tested were nicotine sulphate and derris.

Undersökningar rörande förrådkadedjur. II. Kornmalarna, *Tinea secalella* Zacher och *Tinea granella* L. By R. Mathlein. *Medd. Växtskydsanst.*, 1941, No. 34. (*R. A. E.*, 1943, **31**, A, Pt. 7, 281-282.) Investigations on pests of stored products pyrethrum was found to be most effective; derris inferior; nicotine fumigation effective against adult moths.

Increase Yields of Wax Beans with "Hormone" Insecticide Dusts. By T. C. Allen and E. Fischer. *Canner*, 1943, **96**, No. 22, 12. (*Amer. Chem. Absts.*, 1943, **37**, No. 13, 3872.) Dusts contained specified quantities of naphthalene-acetic acid, rotenone and pyrethrins.

Insect Kill. The Action of Insecticides on Insect Tissue. By A. Weed. *Soap*, 1943, **19**, No. 6, 117-121. Refers to the action of rotenone and pyrethrum.

Effectiveness against the California Red Scale of Cube Resins and Nicotine in Petroleum Spray Oil. By A. W. Cressman. *J. Agric. Res.*, 1943, 67, No. 1, 17-26.

Control of Eggplant Yellows. By S. E. Jones. *Bull. No. 623 Texas Agric. Exp. Sta.* (*Amer. Chem. Absts.*, 1943, 37, No. 14, 4197.) Sulphur-pyrethrum, sulphur-cube and fullers earth-cube dusts all effective in control if applied before infection took place.

Strawberry Insects and their Control in Missouri. By W. W. Smith. *Bull. No. 463 Missouri Agric. Exp. Sta.* (*Amer. Chem. Absts.*, 1943, 37, No. 14, 4194.) Root aphids controlled by nicotine sulphate solution; leaf rollers and slugs by dusts containing derris or pyrethrum or nicotine sulphate; tarnished plant bug and negro bug by nicotine sulphate spray or pyrethrum dust.

Replacement Materials for Roach Control. By G. E. Gould. *Soap*, 1943, 19, No. 8, 90-93, 111. Mentions piperine alkaloid, one of the compounds tested as an activator for pyrethrum and rotenone.

The Control of Pediculosis and Scabies by means of Preparations containing Pyrethrins, Rotenone and aliphatic Thiocyanates. By C. R. Twinn and C. G. MacNay. *Canad. Ent.*, 1943, 75, No. 1, 4-13. (*R. A. E.*, 1943, 31, B, Pt. 8, 167-168.)

The Market Outlook on Insecticide Materials. By P. H. Groggins and H. Noble. *Soap*, 1943, 19, No. 7, 94-96. Discusses the position with reference to pyrethrum and rotenone.

Erfahrungen in der Erdflohbekämpfung. By R. Janisch. *Kranke Pflanze*, 1943, 20, No. 1-2, 7-9. (*R. A. E.*, 1943, 31, A, Pt. 8, 351.) Discusses the use of nicotine, derris and pyrethrum sprays and dusts in controlling flea-beetles in Germany.

Attractiveness of Certain Plant Constituents to the Japanese Beetle. By G. S. Langford, M. H. Muna and E. N. Cory. *J. Econ. Ent.*, 1943, 36, No. 2, 248-252.

Entomological Problems Imposed by War Conditions. By P. N. Annand. *J. Econ. Ent.*, 1943, 36, No. 2, 193-200.

Standardisation of Insecticide Packages. By W. E. Braithwaite. *Soap*, 1943, 19, No. 8, 97-99. Proposals in U.S.A.

ALKALOID-CONTAINING MATERIALS

Tobacco Products, including Nicotine and Nicotine Derivatives

Quantitative Determination of Nicotine and Nornicotine in Mixtures. By N. Markwood. *J. Assoc. Off. Agric. Chem.*, 1943, 26, No. 2, 283.

Aphids. *Agric. J. Vict.*, 1943, 41, Pt. 4, 215. Nicotine spray or dust recommended for control.

The Greenhouse Thrips. *Agric. J. Vict.*, 1943, 41, Pt. 4, 216. Controlled by nicotine and white oil spray.

Fortsatta besprutningsförsök mot plommon-vecklaren. By O. Ahlberg. *Växtskyddsnötiser*, 1941, No. 5, 65-66. (*R. A. E.*, 1943, 31, A, Pt. 8, 320.) Nicotine sprays effective against *Cydia funebrana* on plum in Sweden.

Krysantemumgallmyggan *Diarachnomyia chrysanthemi* Ahlb. och dess bekämpning. By O. Ahlberg. *Medd. Växtskyddsanst.*, 1942, No. 38. (*R. A. E.*, 1943, 31, A, Pt. 7, 283.) Complete control of the eggs of the chrysanthemum gall-midge was given by a nicotine-soap spray.

The Standardisation of a Laboratory Method for comparing the Toxicity of Contact Insecticides. By F. O. Morrison. *Canadian J. Res.*, 1943, D, 35-75. (*Amer. Chem. Absts.*, 1943, 37, No. 14, 4197.) *Drosophila melanogaster* was used as the test insect in toxicity studies with nicotine sulphate and nicotine alkaloid.

Tests of Mississippi Bentonites in Tank-mix Nicotine Bentonite Sprays for Control of the Codling Moth. By L. F. Steiner, C. H. Arnold and J. E. Fahey. *J. Econ. Ent.*, 1943, 36, No. 2, 338-339.

Insect Pests of 1942 [in Scotland]. By A. E. Cameron. *Trans. Highl. Agric. Soc. Scot.*, 1943, 55, 74-98. Refers to the use of nicotine for controlling black aphid and for use in anti-warble dressings.

Some Insect Pests of Lilies. By E. P. Imle and A. Hartzell. *Amer. Lily Yearb.*, 1942. (R.A.E., 1943, 31, Pt. 6, 253.) Aphids on lilies can be controlled by nicotine sprays or dusts in the open and fumigation in the greenhouse.

Tobaccos Classified according to the Nature of Their Alkaloids. By L. N. Markwood and W. F. Barthel. *J. Assoc. Off. Agric. Chem.*, 1943, 26, No. 2, 280-282.

Present Status and Future Trends of Nicotine as an Insecticide. By N. E. McIndoo. *J. Econ. Ent.*, 1943, 36, No. 3, 473-475.

Insecticide from Waste Materials. *Cham. Comm. J.*, 1943, 74, No. 1050, 328. In India tobacco stems and stalks boiled down to a juice, dried and mixed with chalk used to sprinkle on blankets in Ordnance Stores to prevent attacks by white ants, moths, etc.

INSECTICIDE MATERIALS CONTAINING ROTENONE AND ALLIED SUBSTANCES

General

The Effect of Oil in Rotenone Dust Mixtures. By H. F. Wilson and E. J. Campau. *Soap*, 1943, 19, No. 6, 123-127.

Effects of Oxygen and Sunlight on Decomposition of Rotenone in Spray Mixtures. By Francis A. Gunther. *J. Econ. Ent.*, 1943, 36, No. 2, 273-280.

Further Studies on Rotenone and Other Organic Insecticides for Codling Moth Control. By S. W. Harman. *J. Econ. Ent.*, 1943, 36, 200-204.

Life History, Habits and Control of the Beanstalk Weevil (*Sternechus paludatus*) in the Estancia Valley, New Mexico. By J. G. Shaw and J. R. Douglass. *Tech. Bull.* No. 816, U.S. Dep. Agric. (R.A.E., 1943, 31, A, Pt. 8, 316.) Derris or cube dusts ineffective against over wintered adults.

Effectiveness of Cube and Derris Resins in a Tank Mix and an Emulsive Oil against California Red Scale. By A. W. Cressman and B. M. Broadbent. *J. Econ. Ent.*, 1943, 36, No. 3, 439-441.

Rotenone Production in the Amazon Valley. By E. C. Higbee. *Foreign Comm. Wkly*, 1943, 12, No. 4, 8-9, 30.

Revise Rotenone Pricing. *Soap*, 1943, 19, No. 6, 129D. New basis for fixing prices in U.S.A.

Lonchocarpus

Effectiveness against the California Red Scale of Cube Resins in Light-Medium and Heavy Spray Oils. By A. W. Cressman. *J. Agric. Res.*, 1943, 66, No. 11, 413-418.

Derris

The Effect of Diluents on the Toxicity of Pure Ground Derris Root in Dusts. By Neely Turner. *J. Econ. Ent.*, 1943, 36, No. 2, 266-272.

St. Lucia Growing Derris. *Public Ledger*, 1943, No. 33, 214, I.

Derris Root. *Nyasaland Agric. Quart.* J., 1943, 3, No. 3, 5-9. Deals with the propagation, planting and harvesting of derris.

Others

Rotenone in Tephrosia. By M. G. Timoshenko. *Khim. Referat. Zhur.*, 4, No. 2, 71. (Abst. in *Soap*, 1943, 19, No. 8, 96.)

The Yam Bean, *Pachyrhizus erosus* Urban, as a Possible Insecticide. By R. Hansberry and C. Lee. *J. Econ. Ent.*, 1943, 36, No. 2, 351-352.

problem. In that country various control schemes have followed one another over a period of approaching 40 years. The State of São Paulo was responsible for the first valorisation scheme some years before the 1914-18 war. Apart from the special problems of coffee, the work is a useful contribution to the difficult question of commodity control and merits serious attention from this more general aspect. Brazilian experience in this direction provides valuable lessons. The earlier schemes on the whole appear to have been reasonably successful at the time, whatever their long-term effects may have been, later schemes seem to have been definitely less happy. The success of the 1940 Inter-American Coffee Agreement seems to have been due largely to the willingness of the United States consumer to pay somewhat higher prices for the commodity than might possibly otherwise have ruled.

The book contains much valuable information, though perhaps some portions might have been treated a little more concisely, and there is a rather irritatingly large number of footnotes. Incidentally, the author suggests a further shift in demand towards mild coffees which may favour Empire producers. In connection with the expansion of consumption, the author appears to be making a valuable suggestion in drawing attention to the need for simple satisfactory coffee-making equipment, correctly employed, on which propaganda might be based. The coffee industry, it seems, might well consider such a question (page 82). It is interesting to note that the development of the coffee plastic "Cafelite," of which so much was written two or three years ago, is still in the experimental stage. It may be that this prospective outlet will never assume very great proportions.

The work is provided with a number of statistical charts and tables and an adequate index. The Inter-American Coffee Agreement of November 1940 is printed as an appendix.

STARCH AND ITS DERIVATIVES. By J. A. Radley, M.Sc., F.I.C. Second Edition. Pp. xii + 558, $8\frac{1}{2} \times 5\frac{1}{2}$. (London: Chapman & Hall, Ltd., 1943.) Price 36s.

Starch, starch products, the raw materials, the manufacture, and throughout the chemistry and physics thereof constitute a big subject, and the original scientific work in connection with it increases rapidly. The increase from 346 pages in the first edition to 558 in the second edition of this work, which has just appeared, is an indication of this growth. Eleven entirely new or completely re-written chapters and an appendix are included, and the newly added references amount to 1,200. References to literature are a valuable feature of the book, as indeed of the series of monographs on applied chemistry prepared under Dr. Howard Tripp's editorship, of which it is a member. As noticed in the review of the first edition (this BULLETIN, 1940, 38, 455), the works of this series seek

to summarise recent progress in sections of chemical industry. It is therefore not to be expected that exhaustive treatment of the chemical and physical properties of starches, the various sources of starch, the manufacture of glucose, maltose, dextrin, ethyl alcohol and acetone, the application of these products in various industries, and the analysis of starch and dextrin, with which this volume deals, will be found in its 34 chapters, but enough is written to present a very useful picture of the present position of the knowledge of these subjects, and above all to direct the reader's attention to original literature for a more detailed study of a particular section in this field.

As regards the new chapters, those on "The Rôle of Starch in the Plant" and on "The Amylase Action" are particularly interesting, while that on "The Food Industry" covering the part played by starches in various manufactured food powders in confectionery, in bakery, and in the popular potato products, is a most useful and welcome résumé of the subjects. On the general examination of starches there is room for a clearer picture of the control analysis made by the various consumers of starch, and of the standards of purity required by them. In fact this book in common with others sheds very little light on that part of starch chemistry. The table on page 385 giving typical analyses of various starches needs revision, since a typical good quality tapioca starch is considerably superior to the best figures of the range given.

OVERSEA EDUCATION: A JOURNAL OF EDUCATIONAL EXPERIMENT AND RESEARCH IN TROPICAL AND SUBTROPICAL AREAS. (London: H.M. Stationery Office; published quarterly, 1s. per number, 4s. per annum post free.)

This authoritative quarterly journal, which has attained its fifteenth volume, is now published on behalf of the Secretary of State for the Colonies by His Majesty's Stationery Office. The annual volume commences with the October issue, and subsequent numbers appear in January, April and July. Each issue normally consists of 48 pages ($9\frac{1}{2} \times 6\frac{1}{2}$) with a few admirable illustrations. It is excellently printed and well made up considering war-time circumstances. An annual index is provided.

Each number contains three or four articles by various authorities, home and overseas, official and non-official. Foreign contributions also appear from time to time. The current (October, 1943) issue contains the first part of an account of Lovedale, the South African Missionary Institution which has done so much for African education in that Dominion, by Arthur Mayhew, C.M.G., C.I.E. "Some Points of Contrast between Primitive and Civilised Theories of Education" are discussed by Vernon Brelsford, and R. J. Harvey, Headmaster, Teachers' Training School, Mpwapwa, describes "Agricultural Training in Tanganyika." These articles

illustrate the very wide field covered by the journal, and are supported by a comprehensive series of "Notes" comprising matter of interest to educationalists in the Colonial Empire. There follows sections containing a large number of authoritative and well-written book reviews and notices, a quarterly abstract of proceedings of the Advisory Committee on Education in the Colonies, and in some issues miscellaneous notes.

This journal should be well-known and widely read in the Colonial Dependencies. In particular, the annual subscription is very modest in view of the excellent value provided.

MINERAL RESOURCES

ARTICLE

A REVIEW OF GEOLOGICAL SURVEY WORK IN THE COLONIES

By THE INTELLIGENCE STAFF,
Mineral Resources Department, Imperial Institute

AMONG the many problems to be solved after the war are those which arise from the intention to develop further the raw material resources of the Colonial Empire and to encourage local industries in order to raise the standard of living and the purchasing power of its inhabitants. Some £500,000 a year has already been voted for the extension of scientific investigation into Colonial problems apart from development and welfare projects, and the question how best to allocate the grants has for some time been under consideration. It is therefore opportune to draw attention to the wisdom of allocating a fair share of any available grants to the purpose of expanding the work of Geological Surveying in the Colonial Empire. The part which geology can play in the economic and cultural development of a country has many times been pointed out, and it is the purpose of this article to summarise very briefly from published records the position of geological survey work in each of the territories of the Colonial Empire ; since the records vary so widely in scope and completeness of detail, however, it is not possible to present a complete and balanced picture of the position.

Our knowledge of the geology of the Colonies is naturally very imperfect in comparison with that of more highly developed countries, for even the oldest of these Geological Surveys are relatively young institutions, and the staff employed has always been small in comparison with the area of territory to be covered. The geological mapping of the country has therefore in general been carried out only in broad outline by means of rapid reconnaissance surveys, detailed investigations being mainly confined to those areas indicated by the Survey or by private prospecting as likely to contain mineral deposits. In few cases has the geological work reached the stage of systematically preparing a geological map in detail in conformity with a mathematical scheme of division of the territory concerned. This, perhaps, is not surprising when it is realised that the total number of trained personnel is only about 46

officers to cover the area of some $1\frac{1}{4}$ million square miles of territory in which Geological Survey Departments exist, and when it is borne in mind that a considerable proportion of the officers' time is taken up in carrying out routine duties such as visiting mines and prospects, considering water supply and public works problems, examining specimens, etc. The balance of about 1 million square miles of Colonial territory is without any official Geological Survey; in fact, three of the largest countries—Northern Rhodesia, Bechuanaland and Aden Protectorate—are in this category. Hitherto, the expenditure on Geological Surveys has been small in comparison with that on various analogous departments, and geology has never received the consideration it deserves in the Colonies. Frequently the Survey has not been an autonomous department, and has usually been the first to suffer when retrenchment has been enforced.

In the view of the Imperial Institute a Geological Survey should be regarded as a public service available to the mining, agricultural and other industries as well as for the furtherance of public works activities, as an instrument for the finding of adequate water supplies and as an educational institution. Many Colonial Surveys can show a very good record of revenue directly attributable to their mineral discoveries, but they should not be regarded as mere prospecting departments and judged according to their revenue-producing capacity.

Colonial geological survey work is often hampered by the lack of good topographical maps so that geologists often have to do topographical surveying before they can fill in the geology, and it should not be necessary for Geological Survey officers to do this work. On the other hand, the finding and developing of an adequate supply of water for native populations, which is a matter of paramount importance especially in many African colonies, should logically be carried out under the direction of the Geological Survey. In some Colonies, however, this work has assumed such proportions as to have taken up almost the whole time of the Department, a circumstance which might be obviated by having a separately-financed water supply section of the Survey.

Geologists for Colonial survey work are called upon to do every type of geological work and to have a knowledge of applied as well as pure geology together with some knowledge of mining and of topographical and mine surveying. Young men straight from Universities in this country, who are recruited for the Colonial Surveys, have not as a rule received sufficient training in all these subjects to fit them at once for the carrying out of the tasks they are called upon to do, and the question of establishing special courses of training for officers for the Colonial service merits consideration.

The method adopted in the early years of the present century of carrying out Mineral Surveys under the auspices of the Imperial Institute as a preliminary to the formation of a Geological Survey

in territories where little was known of the geology and potential mineral wealth had much to recommend it. These Mineral Surveys appear to have located most of the economic mineral deposits in the countries in which they were carried out.

In the following summary of geological work in the Colonies, the small islands and groups where the question of establishing official Surveys hardly arises have not been included.

WEST AFRICA

Gold Coast

The Gold Coast comprises an area of approximately 92,000 sq. miles with a population of nearly 4 million. It affords a good example of the importance and value of an efficient Colonial Geological Survey, for the mining industry of the country owes its virile position in no small measure to the excellent pioneer and reconnaissance work of its Geological Survey officers.

Geological Survey

The official survey was originally formed in October 1913, and has since been responsible for the discovery, *inter alia*, of important deposits of manganese ore, diamonds and bauxite. Moreover, it has played a significant part in the opening up of these deposits by encouraging influential companies to work them. Yet for all these services, the total expenditure of the Survey up to the end of the financial year 1938-39 has only amounted to just over £186,000, or approximately £7,000 annually, which is much less than the large sums of money expended on private geological surveys by influential companies operating in such countries as Northern Rhodesia. During the same period the estimated value of the Colony's mineral output for gold, diamonds and manganese was £52,000,000, so that the cost of the Geological Survey of the Gold Coast has amounted to roughly one-third of one per cent. of the recorded mineral production. The over-all expenditure for the 12-year period 1914-1925 as shown in published itemised statistics was £74,442, of which £42,168 (or 56½ per cent.) represented personal emoluments, £4,487 (6 per cent.), passages of officers to and from the Gold Coast, £3,044 (4 per cent.), stores, tools and instruments, and £13,313 (18 per cent.) carriers and labourers.

The European staff of the Survey comprises one Director, one Deputy Director (post vacant), one Senior Geologist, three Geologists (one on war service), one Superintendent of Records (in London office) and a water-supply section consisting of one Engineer and one Foreman. This establishment, however, is not indicative of the actual working strength of the Survey over the past two decades or so; indeed, the bulk of the geological work during this period was carried out by only three or four officers.

Discoveries of Mineral Deposits

In the early stages of its development the work of the Geological

Survey was chiefly confined to covering the country as rapidly as possible by a network of reconnaissance traverses. The efforts of the geologists were soon attended with success, for in 1914 A. E. Kitson (later Sir Albert Kitson) discovered the large deposits of manganese ore at Nsuta, which are now being worked on a large scale, and the bauxite deposits at Ejuanema near Nkawkaw railway station. In 1919 the first diamonds were discovered at Abomoso by Mr. Kitson and Dr. E. O. Teale (later Sir Edmund Teale), and in the following year Mr. Kitson and Dr. Junner (the present Director of the Survey) found diamonds at many places between Oda, Kade and Manso. The diamantiferous gravels in this area are now being worked extensively by companies. Diamonds are also worked near Dompim in the Tarkwa District, the original discovery being made by Dr. Junner in 1922. In 1921 and 1922 the large bauxite deposits near Sefwi Bekwai and Yenahin were discovered by the Geological Survey.

Latterly the work of the Geological Survey has been of a more detailed nature, but reconnaissances are still being carried out in districts not previously examined. Investigations in considerable detail have been made of the Tarkwa, Prestea, Obuasi, Bibiani and Konongo goldfields, as well as of the Birim diamond field, the Nsuta manganese deposits, and the chief bauxite deposits. A comprehensive survey of the gold resources of the Colony and Ashanti has been carried out, and the Northern Territories have been investigated. In the course of this work many new occurrences of gold, diamonds, manganese and other minerals were found.

Water Supplies

The Water Supply Section of the Department, which was formed in 1937 to construct dams, ponds and wells in the Northern Territories, was in active operation until the outbreak of War, when the Department formed two Water Supply Units for the Gold Coast Regiment. Three geologists, the engineer and two foremen, who were released for this purpose, served with distinction in Kenya, Somaliland, and Abyssinia, and later in the Gambia.

Maps and Publications

The first provisional geological map of the Gold Coast was published in 1928 and a revised coloured map with accompanying textual descriptions and photographic plates was issued in 1940, the map being on a scale of 1 : 1,000,000. In 1934 a new geological map of the southern section of the Gold Coast showing the various gold mines and prospects was also published : this was on a scale of 1 : 500,000. The other principal publications of the Survey to date include 14 bulletins, 6 detailed memoirs, 7 sessional papers, annual reports of the Department from 1913 to 1940, reports of investigations into the water supplies of the Northern Territories and the coastal area of the Eastern Province, and a general report on the geology and mineral resources of the country.

From the above it will be seen that the broad aspects of the geology of the Gold Coast have been covered fairly satisfactorily, and that the principal metalliferous and economic mineral areas so far known have generally been described in appreciable detail. Even so, the total area geologically surveyed on a scale 1 : 62,500 or greater does not appear to be as much as one per cent. of the area of the territory, nor is there yet any comprehensive geological map of the country equivalent to the $\frac{1}{4}$ in. map of the United Kingdom—sometimes regarded as the minimum essential requirement of a first-class established Survey. Much work, therefore, still remains to be effected, but the most urgent needs from the economic and social aspects appear to be investigations in connection with water supplies, non-metallic minerals for local industries, such as building and pottery, and buried mineral deposits. A hydro-geological survey of the Northern Territories and the Eastern Province of the Colony, combined with experimental drilling and geophysical surveys, seems necessary, and geological and geophysical surveys are also required to locate buried mineral deposits along the main gold channels and to trace the extension of the important Ashanti gold channel under the cover of Voltaian rocks to the north-east of Konongo.

Nigeria

The Colony and Protectorate of Nigeria is the largest single unit of the Colonial Empire, comprising 372,674 sq. miles, with a population of about 20 millions. Its mineral resources constitute a valuable asset, and important deposits of tin ore, gold and coal, in addition to other minerals, are being exploited. Nigeria is also the leading world producer of columbite, formerly regarded as a waste product of tin mining, but now as a useful ingredient for special alloy steels.

Preliminary Surveys

Up to the beginning of the present century, the mineral resources and geology of the country were virtually unknown, and, in consequence of this, a Mineral Survey of Southern Nigeria was established in 1903 to obtain accurate information respecting the occurrence of minerals of economic importance as a first step towards their development. A similar Survey for Northern Nigeria was instituted during the following year. Both these Surveys were carried out under the auspices of the Imperial Institute and were sanctioned by the Colonial Office. Specimens of all important minerals collected were accordingly forwarded, together with periodical descriptive statements by the Mineral Surveyors, to the Imperial Institute for chemical analyses, technical trials and commercial valuations. The results obtained were later summarised in 14 separate reports issued by H.M. Stationery Office as *Colonial Reports—Miscellaneous*.

These reports were of considerable economic interest and

demonstrated *inter alia* the occurrence of large quantities of good-quality coal at Udi and of tinstone over wide areas in the provinces of Bauchi, Kano, Zaria and Nassarawa. In 1910 capital began to be attracted to the country, and in particular the possibilities of the Nigerian tinfields began to be explored commercially.

The Surveys, whilst essentially of an economic nature, established important geological data, and in 1911 Dr. J. D. Falconer, who had been the principal officer of the Mineral Survey of Northern Nigeria, 1904-9, correlated many of the disconnected records in the Surveyor's notebooks in a valuable work entitled *The Geology and Geography of Northern Nigeria*. This work included a coloured geological and topographical map with sections of Northern Nigeria on a scale of 1 : 2,000,000.

Geological Survey

Although the possibilities of Nigeria as a mineral producing country had thus been indicated, it was not until 1919 that an official Geological Survey was established. Dr. Falconer was appointed Director of this Survey, assisted by Capt. R. C. Wilson, and it was decided to undertake simultaneously the survey of the tinfields in the Northern Provinces and the survey of a belt of country along the western railway in the Southern Provinces. In 1920 the scientific staff was increased by the appointment of three geologists, and by April 1942, according to the official Classified Staff List, the establishment was as follows: one Director, one Deputy Director (seconded to Cyprus), one Senior Geologist, two Geologists, one Senior Water Supply Engineer (vacant), two Water Supply Engineers, six Foremen, one Drilling Superintendent, and one Driller (vacant).

The total expenditure of the Survey from its formation in 1919 up to the end of the financial year 1938/9 amounted to £187,031, including special grants for 1929/30 and 1931/2. This is equivalent to £9,352 per annum. The maximum expenditure for any one year was £15,304 in 1938/9, of which £11,825 (or 77.3 per cent.) was absorbed in personal emoluments, £2,578 (16.8 per cent.) in transport and travelling, and £492 (3.2 per cent.) in labour and artisans at various rates of pay. Estimating the value of the mineral output for the same year at roughly £1½ millions, it will be seen that the expenditure of the Survey is about 1 per cent. of this amount. Since 1929, however, the Survey has concentrated largely on water supply problems, and at the outbreak of the present war, seven members of the European staff of the Department and 32 African well-sinkers were embodied in the Royal West African Frontier Force as a Water Supply Section of the Engineer Unit. The normal activities of the Department have consequently been seriously curtailed. In 1942, on the formation of the Wolfram Board, the Department co-operated with it and devoted its chief geological work to the investigation of wolfram deposits and their associated tinstone or columbite.

Maps and Publications

There is a coloured provisional geological map on a scale of 1 : 2,000,000 (1 in. to 31·56 miles), the latest edition of which, issued as an appendix to the Survey's annual reports, was published in 1934. There is also a large geological map consisting of two coloured sheets of the Nigerian tinfields: this was published in 1927 and was compiled by Dr. Falconer on field work carried out from 1919-1926. It is on a general scale of 1 : 250,000 (1 in. to 3·95 miles) and covers five separate areas, viz. (1) Jos-Bauchi, (2) Faiki, (3) Calabar (1 : 536,625), (4) Afu Hills, Nassarawa Province, and (5) Ilorin (1 : 262,000).

The most recent geological map, also on a scale of 1 : 125,000, deals largely with wolfram occurrences, and incorporates parts of the Ningi, Riruwai, Toro and Leri minefield priority sheets.

In addition to the above, the Survey has also published 16 bulletins, Departmental annual reports, various occasional papers, and a special report on the water problems of Nigeria. Half-yearly reports by the Director are also forwarded to the Imperial Institute for inclusion in the *Bulletin of the Imperial Institute*.

Water Supply

Since 1929, as previously stated, the activities of the Geological Survey have been directed mainly to the investigation of water supply problems in the more arid parts of the Northern Provinces and to carrying out well-sinking schemes, and by the end of 1939 1,313 wells had been sunk by the Department, 315 of which were in the Sokoto area, 179 in the Borau area, 176 in the Katsina area, 139 in the Kano area, 119 in the Hadejia area, and 101 in the Gummel area, the remaining 284 wells being sunk in the following areas, in decreasing numerical order: Katagum (58), Daura (56), Owerri (47), Sleeping Sickness (37), Argungu (27), Fika (12), Aba (11), Kazaure (9), Ishan (7), Kaiama (7), Misau (5), Gwandu (4), Bauchi (2) and Gombe (2). These wells provide water not only for towns and villages, but in many cases for large herds of cattle during the dry season. Shafts have also been constructed in tracts of virgin bush, thus leading to settlement and the cultivation of new areas. They vary in depth from about 25 ft. to over 300 ft., with an average of roughly 150 ft.; the internal diameters have been standardised at 4 ft., although in special cases diameters up to 9 ft. or so have been used. Perhaps the most important and spectacular feature of this work has been the demonstration that sub-artesian water underlies great stretches of country occupied by younger sedimentary rocks and its successful exploitation by means of open shafts. Tube-wells fitted with pumps specially designed to stand up to local conditions have been recommended and installed in suitable localities. The Department just prior to the war received a request for tube-wells to irrigate gardens along the River Challowa in Kano Province, and it is believed that there is a large field for work of this nature in the drier areas of the Northern Provinces.

With the purchase in 1936 of an Edeco percussion drill from Loan Funds the Department entered a new field of activity.

The general geology of the country appears on the whole to have been adequately elucidated at the present time and satisfactorily presented by means of a series of good maps with accompanying texts to enable mining companies to formulate policy and to suggest to their own mining geologists and engineers the various terrains which might well repay detailed re-investigation. These remarks apply particularly to the elevated hinterland. The policy of the Survey in concentrating on water supply problems seems well advised, and appears to be one most likely to benefit the native population to the fullest extent.

Sierra Leone

The Colony and Protectorate of Sierra Leone together cover a total area of 28,000 sq. miles with an estimated population of about 2,000,000. From a geological point of view the country has never been surveyed in detail, and as late as 1918, when the first Geological Survey was formed, practically nothing was known of its geology nor had it been surveyed topographically. Dr. Dixey, the sole Government Geologist, accordingly made three tours of the country during the years 1918 to 1921, and in addition to forming some general idea of the structure of the region, succeeded in producing a preliminary geological sketch map. His results were summarised in three Departmental annual reports for 1918-1919, 1920 and 1921, and were further elaborated in a paper entitled *The Geology of Sierra Leone*, published in the *Quarterly Journal of the Geological Society*, Part 2, 1925. Dr. Dixey, in his final report, remarked: "Whilst it is obviously impossible for one geologist, in the course of three short tours, to examine in detail a country which is practically the size of Ireland, it is nevertheless hoped that the work of the present Survey has been sufficient to lay down at least the broad outlines of the Geology of Sierra Leone, and also to serve as a useful basis for any further investigation that might be made into the mineral resources of the country." As, however, no important deposits of economic minerals were discovered during this brief preliminary work, the Survey was wound up.

In 1926, at the request of the Governor of Sierra Leone for advice as to the resumption of a geological Survey, A. E. Kitson (later Sir Albert Kitson), Director of the Gold Coast Geological Survey, suggested the seconding of Dr. Junner from the Gold Coast for the purpose of making a rapid survey of certain areas which Mr. Kitson from previous work considered worthy of careful examination. As it happened, no minerals of economic importance were discovered, but Dr. Junner took the opportunity of prospecting other areas not included in the original itinerary and was successful

in finding iron ores in the Marampa Schists as well as alluvial gold and platinum deposits near the Pampana river. In 1927 he was appointed Director of a new Geological Survey of Sierra Leone, and was joined in the following year by J. D. Pollett as Assistant Geologist. A Mines Office was also opened in 1928, and the Director of the Geological Survey further became Chief Inspector of Mines with a staff of two Inspectors of Mines.

Dr. Junner continued as head of the combined Geological and Mines Department until 1930, when he returned to the Gold Coast Geological Survey as Director. As a result of his work, practically all the important deposits of economic minerals so far discovered in the country, e.g. diamonds, iron ore, gold, chromite, platinum, etc., were brought to light and developed.

Mr. Pollett now became the only geologist in the Department, holding the title of Assistant Geologist until 1938, when it was altered to that of Geologist on the coming into effect of the unification of the Colonial Geological Service. Although single-handed, Mr. Pollett has carried out many important duties and investigations, but for some time past he has been called upon to act in the capacity of a District Commissioner, with the consequence that very little geological work has been carried out since the beginning of the war.

The only geological maps of Sierra Leone are Dixey's preliminary sketch map, Junner's provisional geological sketch map (reproduced on a reduced scale in *Mining Magazine*, February 1930) and Pollett's map on a scale of 1 : 500,000 for the British Empire Exhibition at Glasgow in 1938.

As Sierra Leone appears to be a country warranting serious and systematic geological investigation, especially by modern methods, e.g. geophysical prospecting, it would seem highly desirable that priority of consideration should be accorded to this particular Colony. In 1938 the estimated value of the mineral production was £1,684,240, the direct revenue to the Colony from the mining industry being £174,468.

The Gambia

The area of the Colony and Protectorate of the Gambia is 4,132 sq. miles, consisting for the most part of a strip of country on either bank at the mouth of the Gambia River. The geology of the country was investigated during two rapid traverses made in 1925 by W. G. G. Cooper, of the Gold Coast Geological Survey, at the instigation of the Colonial Office. His report was published as Bulletin No. 3 of the Gold Coast Geological Survey and contains a coloured geological map on a scale of 1 : 500,000 and several sections. The rocks are entirely Tertiary and Recent sediments; economic minerals were not found to occur in commercial quantity except clay which might be used for local brickmaking and pottery.

EAST AFRICA

Northern Rhodesia

Northern Rhodesia has a land area of 290,323 sq. miles, but is only sparsely populated. The country became the leading mineral producer in the Colonial Empire shortly before the present war began, the value of the copper, cobalt, vanadium and zinc produced being some £12,000,000 annually. Mining is the principal European industry, providing more than 95 per cent. of the country's exports, consuming the bulk of its imports, and contributing the greater part of the Government's revenue.

As far as geological investigations go the country may be considered in two parts. In the Barotseland Native Reserve, covering 57,530 sq. miles, European development is not permitted, and the geology is little known apart from a few generalisations concerning soil geology and water supply. In the remainder of the country detailed geological surveying has been carried out by concession companies during the past 20 years. Throughout this extensive tract the mineral rights are owned by the British South Africa Company, except in the south-eastern area, covering 10,000 sq. miles between Fort Jameson and the Luangwa river, where this company has made over its mineral rights (apart from oil and precious stones) to the North Charterland Exploration Company (1937) Ltd.

Geological Surveying

No official geological survey department has been established in Northern Rhodesia, but shortly after the country became a Crown Colony in 1923 geological surveying was begun by concession companies holding exclusive prospecting licences granted for limited periods by the British South Africa Company. Initially several groups of geologists took part, and attention was concentrated on the copper bearing regions, the most notable work being done by the Selection Trust, Ltd., in the Nkana concession, 1,800 sq. miles in area, in which the greater part of the copper resources of the country have been located. From 1927 onwards the work was extended systematically to cover three-quarters of the country, and was carried out under the direction of Dr. J. A. Bancroft, Consulting Geologist of the Anglo American Corporation of South Africa Limited. Most of the areas were traversed at quarter-mile intervals and mapped on the scale of 2 inches to 1 mile. The work was ended in 1940 by which time the whole of the concession areas, including part of the North Charterland Exploration Company's area, had been mapped in detail, except for a few small districts which had to be left unexamined or given only a rapid reconnaissance survey.

This survey, lasting for more than 12 years with from 6 to 40 and at times even 90 geologists in the field for 12 months of the year, was far more detailed and involved much greater financial expenditure than any Government geological survey in the colonies.

The information contained in the maps prepared should be of great value to all concerned in the development of the colony, and, now that most of the country is again open to public prospecting, in the development of mining in new areas. Geological maps on a scale of 2 miles to the inch, together with regional maps on a scale of 10 miles to the inch, are now available for consultation in Northern Rhodesia, and a comprehensive report on the geology of the country is also in course of preparation. At present the only published geological maps, apart from the generalised maps of early reconnaissances, are of a few small areas described in special papers mainly by geologists who took part in the mapping of the concessions, including a coloured map of the Nkana concession on a scale of 4 miles to the inch, and maps by Dr. F. Dixey of parts of the Luangwa rift valley.

Mining

Mining is at present practically confined to two districts, the Copperbelt, where copper and cobalt are produced and a little local quartzite, limestone and iron ore are consumed, and Broken Hill, where vanadium, zinc and lead are produced and manganese ore from nearby is used. Elsewhere a little gold, mica and tin have been mined. Minerals which probably occur in economic quantities but are as yet not utilised include coal, cupriferous pyrites and perhaps graphite. The following table shows the value of mineral production in recent years :

	1937. £'000.	1938. £'000.	1939. £'000.
Copperbelt . .	12,237	10,257	10,936
Broken Hill . .	482	410	522
Other Mines . .	32	16	55
 Total . .	 12,751	 10,684	 11,513

Water Supply

The need for an adequate supply of water in many parts of the country has long been recognised and in 1938, Dr. F. Dixey, Director of the Geological Survey of Nyasaland, was called upon to prepare a scheme for the development and conservation of water supplies in Northern Rhodesia. He outlined a six-year programme of development which was approved in the following year when a Water Development Department was established with Dr. Dixey as Director. The Colonial Development Advisory Committee which approved the scheme made an initial grant of £50,845 for work in Native Reserves in the Eastern Province, and undertook to consider additional grants up to a total of £135,000. Work began in the Eastern Province in August 1939, with well sinking, and water boring was begun in 1940. Development was to be extended to the Central and Southern Provinces commencing in 1941, but details of development since 1939 have not been published.

Nyasaland

Nyasaland, with a land area of 37,374 sq. miles, is the smallest colony in East Africa, but has the highest average density of population. Geological investigations carried out in the country have included the Mineral Survey under the auspices of the Imperial Institute in 1906-1908, the work of the Geological Survey Department since 1921, and investigations on behalf of the British South Africa Company which owns the mineral rights over 40 per cent. of the country. Despite this work and the discovery of coal, bauxite, limestone and other mineral deposits, no mining industry has been established. This is unfortunate as the lack of industries in Nyasaland has been accompanied by serious emigration of the natives, the majority of wage earners being employed outside the country. The Geological Survey Department has also rendered valuable service by its water supply investigations which have opened up new areas for human settlement and greatly improved the living conditions of the natives, but the survey of both mineral resources and water supplies is still far from complete.

Geological Survey

The Imperial Institute Mineral Survey was carried out by A. R. Andrews and T. E. G. Bailey, who in $2\frac{1}{2}$ years field work extended a network of traverses over the whole territory. The findings of the survey were published as three Colonial Office reports and a paper on *The Geology of Nyasaland* published by the Geological Society in 1910, and have formed a sound basis for later investigations. A Government Geologist was appointed in 1918, and the Geological Survey Department was established in 1921 under Dr. F. Dixey. Since then a staff of one to four geologists has been employed in mapping, examining mineral areas, and water supply investigations, except in 1932 and 1933, when work was confined entirely to water supply.

Economic investigations were first made in the coal areas, and later, on the bauxite deposits which Dr. Dixey discovered in 1924; reports on limestone resources and cement-making materials were also published. In 1934 a grant of £9,000 from the Colonial Development Fund was authorised for the investigation of mineralised areas, and shortly afterwards this was increased to £18,000. Various areas and deposits were examined—the Blantyre sulphide ores, Lisungwe gold deposits, mica, graphite, manganese and asbestos deposits, and the minerals in the Kirk Mountains and Port Herald Hills.

The geological mapping of the country has proceeded piecemeal, field work varying from 700 to 3,000 sq. miles a year, much of it however being reconnaissance rather than detailed work, for the time spent in mapping has been relatively short owing to the other duties of the staff and the short field season in many areas. About 20 geological maps, in varying degrees of detail and covering different but frequently overlapping areas have been published.

The best published geological map of the whole territory is very generalised and only on a scale of about 1:4,000,000.

Private Investigations

In 1936 the Colonial Office and Nyasaland Government confirmed the British South Africa Company's title to mineral rights over 16,000 sq. miles, and the Company agreed to examine the areas within a specified period. Six geologists of the Anglo American Corporation of South Africa began field work in 1936, and it was completed by 1939. The areas comprise some 6,000 sq. miles in the Fort Hill—North Nyasa district and about 10,000 sq. miles in West Central Nyasaland, and although it has been stated that no important mineral discoveries were made, no details have been published. Geological maps were prepared and a complete series in nine sheets was presented to the Nyasaland Government. In 1939 this Company's geologists began a detailed examination of the Mlanje bauxite deposits (which are outside their mineral areas) and later employed a Survey geologist to examine the Sumbu coal areas, but as yet no decisions as to the practicability of exploitation have been arrived at.

Water Supply

Although Nyasaland has the highest average density of population of the East African colonies, two-thirds of the country is only sparsely populated or uninhabited owing to the absence of surface water supplies. Water supply investigations have therefore been a major part of the Geological Survey's work ever since its foundation, and since 1931 have been financed entirely from the Colonial Development Fund. In the ten years 1931-40 about 4,200 sq. miles of selected territory was investigated, and 68 boreholes and 455 dug wells were completed, in all yielding a minimum of 1,614,600 gallons of water daily. It is estimated that this supplied a native population of at least 107,000 and opened up 780 sq. miles of new land. Much more work remains to be done, and it was stated at the end of 1940 that a minimum of 788 wells, 86 boreholes and 16 dams were still required to render native conditions satisfactory.

Tanganyika Territory

Tanganyika, the largest dependency in East Africa, has a land area of 339,000 sq. miles, but nearly two-thirds of the territory is uninhabited. Geological investigations were begun by Germans at the end of the last century, and before 1914 gold and mica were being produced, soda and coal deposits had been investigated, and diamonds had been found. Under British Mandate further considerable progress has been made. The Geological Survey Department has established the main framework of the geology of the country, reported on all the producing mineral areas, and begun the development of the underground water resources as a result of which much of the country at present uninhabited may eventually be utilised. Concurrently, tin deposits, diamond fields and new

gold areas have been opened up, and the annual value of mineral production had increased to more than £500,000 in 1936 and £1,000,000 in 1939.

Geological Survey

The Geological Survey Department, which was established in 1926 under the direction of Dr. E. O. Teale (now Sir Edmund Teale), who had previously been Government Geologist for a short period in 1921, was incorporated in the Department of Lands, Mines and Surveys in 1935. In recent years the staff has consisted of one Chief Geologist and from four to seven Geologists, together with several Drill Foremen. Expenditure has been of the order of £10,000 on geological work and £5,000 on water supply annually, of which, since 1935, the greater part has been met by grants from the Colonial Development Fund. Development of the economic resources of the Territory has always been the declared object of the Geological Survey, and work has been largely confined to mineral areas and water supply.

Some 20 bulletins and short papers on the mineral areas have been published, accompanied by geological maps on scales varying from 1 : 250,000 to 1 : 50,000, including the following : Lupa Goldfields; Musoma Goldfields and extensions; Saragura Goldfields, Mwanza; Mpwapwa District; Uruwira Mineral Area; Ruhuhu Coalfields; Ufipa Coalfields; Iramba Plateau; Karagwe Tinfields. These cover a total area of some 12,000 sq. miles. Several of them are provisional reports published as quickly as possible so as to be of use in the early stages of development of mineral fields and subject to revision and elaboration when more field work and mining have yielded further evidence.

A uniform plan for the preparation of geological maps on degree sheets, each covering 1 deg. latitude and 1 deg. longitude (roughly 4,300 sq. miles) on a scale of 1 : 250,000 has been adopted, and 97 sheets will cover the whole territory. To date, four have been published, covering a total land area of about 14,400 sq. miles, and by the end of 1938, three or four more sheets were well in hand. These sheets cover areas of economic importance in different parts of the country. All areas are not investigated in the same detail, and aerial reconnaissance has been used to select areas most deserving of detailed examination.

A provisional geological map of the whole territory was first issued in 1932, and a second edition was published in 1935 on a scale of 1 : 3,000,000. On this map nearly a third of the land area is blank. A third edition was in preparation in 1938 on a scale of 1 : 1,000,000 and it was proposed that this map should be brought up to date each year.

The area of country mapped each year has varied considerably, but was greatest in the years 1936-38, when it averaged 6,000 to 7,000 sq. miles. Up to the present it would appear that only about a tenth of the Territory has been examined in detail.

Mining

The rapid growth of the mining industry in the last decade has been confined almost entirely to gold production, which by 1940 accounted for roughly 90 per cent. of the total mineral production. Other minerals—salt, tin ore, mica and diamonds—are mined only on a relatively small scale. Increased production of these would give a better balance to the mining industry, and the working of coal might assist the development of other industries and transport. The Geological Survey Department has directly aided the mining industry by its field work, publications, and the assaying and metallurgical testing of ores submitted by prospectors.

Water Supply

About one-third of the expenditure of the Geological Department in recent years has been for water supply purposes, mainly on a boring programme. Between 1932 and 1938 the Department made 109 borings of a total depth of 26,252 ft., of which 71 per cent. were successful, and in all yielding 3.3 million gallons of water in 24 hours. Sisal estates in particular have benefited considerably by the provision of bore-hole water supplies.

Kenya

In the colony of Kenya, which covers an area of 225,000 sq. miles, the mineral industry is second in importance only to the industry of coffee growing, and in 1938 the mineral output was valued at more than £650,000. The only economic minerals produced in quantity are gold and soda, and although base metals are known to occur the information available is not yet sufficient to indicate their potential importance.

Geological Survey

Official geological work in the country commenced when Sir Albert Kitson was commissioned in 1932 to organise a geological department and to examine the mineral resources of part of Kenya in connection with an application by Tanganyika Concessions Ltd. for an Exclusive Prospecting Licence of 5,000 sq. miles in North, Central and South Kavirondo.

A combined Mining and Geological Department was formed on January 1, 1933, and although one chemist and assayer and four inspectors of mines were appointed, there was only one geologist. The establishment of the geology section just before the war was one geologist, one assistant geologist and one chemist and assayer, and the average pre-war expenditure on the combined department was of the order of £10,000 a year. In 1939 a free grant of £30,000 from the Colonial Development Fund was obtained in order to carry out the examination of several areas deemed worthy of special treatment, but this grant was later reduced to £15,000 owing to the war. For a period, geologists from other colonies who were serving with the Forces in Kenya were seconded for special work in the Colony.

Although the Geological Survey has accomplished a great deal with a very small staff, and notwithstanding the private prospecting by individuals and firms, only about 10 per cent. of the country has been surveyed in any detail. A larger staff with secured finances appears to be needed for the surveying of the colony in general.

Geological Maps

The geological map of the whole country which is generally available is the uncoloured sketch map on a scale of approximately 1 : 5,000,000, which shows the major formations. Other sketch maps on a scale of 1 : 1,000,000, such as that showing the most promising areas for gold prospecting and one of the geology of the western half of Kenya, have also been issued.

The most detailed maps produced are those published by the Survey, accompanying the reports on special mining areas, and those produced by private firms, copies of which have been lodged with the Geological Survey.

The areas surveyed by the Geological Survey include the No. 1 mining area (1 : 25,000), the No. 2 mining area (1 : 63,360) and Lolgorien, Kakamega and W. Kakamega. The areas privately surveyed include those of Karunga, Mount Elgon and Rusinga Island, whilst the areas surveyed by large companies are the Kaimosi section of Kakamega (Sir Robert Williams & Co.), S. Kavirondo (Kenya Consolidated Ltd.) and Block 41, S. Kavirondo (Swedish Mining Syndicate).

During the war, the detailed examination of certain areas considered by Kitson to be worthy of exclusion from open prospecting has proceeded. These areas, which total 4,085 sq. miles, are Mtito-Andei-Tsavo, Maragoli and S. Kavirondo.

Aerial Surveying

Various areas of Nyanza Province have been aerially surveyed in accordance with the conditions of the grant of certain Exclusive Prospecting Licences, but although the use of this method by Government for other parts of Kenya has been under consideration it has not been widely adopted. By 1934 the Government had obtained excellent air survey maps of some 2,500 sq. miles of the Colony. Those of Tanganyika Concessions Ltd. are on a scale of 1 : 25,000 for No. 1 area N. Kavirondo and on 1 : 62,500 for the Yala basin. Kenya Consolidated Ltd. also had topographical maps made by air survey.

Uganda

Uganda has an estimated land area of 80,301 sq. miles and a population in excess of 3½ millions. It includes some 9,003 miles of the "Mailo" lands of the Buganda agreement of 1900, over which the Crown has no rights and where private prospectors are unlikely to be attracted in normal times. The Geological Survey, however, has recently been granted permission by the native authorities to investigate part of this region.

In 1937, the mineral industry of Uganda (gold £124,713, tin ore £76,633) was fourth in importance to the value of cotton, coffee and cotton seed. Nearly all the gold won in the Colony has been from areas discovered by the Geological Survey, although the output is now declining, and the latest figures show the value to have dropped below £100,000 annually. This is largely attributed to the working out of the gold alluvials in Buhwezu and elsewhere. Busia is the only field which holds any promise for lode-gold mining in Uganda in the near future.

Geological Survey

The Geological Survey was formed in 1918 by the appointment of E. J. Wayland to the Uganda Land Office. It has gone through many vicissitudes as regards staff, being almost entirely eliminated in 1922, reaching a total of five in 1930 and being subjected to severe retrenchment again in 1932. The current establishment is one Director, two Senior Geologists and four Geologists.

There has always been a heavy call on the department for assays, examination of specimens, and advice on soil erosion and water supply problems, and it is not surprising therefore that, by 1937, only 3,855 sq. miles of the colony had been mapped. Indeed, water supply problems have always occupied much attention of the Survey, for the country is believed to be drying up, and the opinion is consequently held that the institution of a hydro-geological survey is as necessary as the practical work of drilling. The Survey has demonstrated the efficacy of geophysical prospecting, particularly by the resistivity method, in selecting sites for boring for water in the Colony.

A notable handicap to geological surveying in this colony is the lack of roads and good topographical maps. Furthermore, the solid geology is masked by a heavy blanket of laterite, thick soil and vegetation, while the sluggish nature of the watercourses and the occurrence of swamps do not permit of good rock exposures. In country of this nature, therefore, it is manifest that only detailed geological or geophysical surveying are likely to reveal deposits (if any) of economic interest.

Geological Maps and Reports

A provisional coloured geological map on a scale of 1 : 1,000,000 has been issued (1940) replacing earlier ones issued in 1936 (un-coloured) on a scale of 1 : 1,000,000 and one issued in 1929 on a scale of 1 : 2,000,000. A blue-print "geological diagram-map" on a scale of 1 : 300,000 of part of S.W. Uganda was issued in 1926. Detailed maps on scales of 1 : 125,000 and 1 : 50,000 of certain parts of the Colony (such as the Musoma goldfield and the Ankole tinfield) have also been issued.

During the present war, a report together with a supplement drawn up by the Director of the Geological Survey describes the minerals and mineral deposits which occur in Uganda, dividing them

into those worthy of investigation, those known to occur in small quantities and those found only in traces. The report is accompanied by a sun-print map (1 : 2,000,000) of these occurrences.

Private Investigations

A fair amount of prospecting has been carried out in Uganda by mining engineers and prospectors. The D'Arcy Exploration Co. has prospected for oil in the Lake Albert depression, surveying and geophysical prospecting of certain small areas has been carried out by Tanganyika Concessions Ltd., and the African and European Investment Co. have spent £100,000 on prospect drilling for oil in the Butiaba and Kibero Areas.

Somaliland

The area of the Protectorate is 68,000 sq. miles, of which only 800 sq. miles are arable. All the land, except in proclaimed townships, may be regarded as vested in the Somali tribes.

Geological work was carried out by one Government Geologist from 1923 until 1934, and with the intensive search for oil which has been prosecuted privately, it is unlikely that mineralisation on a large scale exists and has been overlooked. On the other hand, probably less attention has been given to the natural resources of the country as far as they might supply building, ceramic, pigment, filler, and similar materials for local use. It would appear that here, as in other little-developed colonies, the services of a geologist for dealing with questions of water-supply, public works and the like would be highly beneficial.

Geological Survey

From 1901 to 1922 mineral samples obtained in the Protectorate were sent by the Administration to the Imperial Institute for examination, but in 1922 as a result of a suggestion by the Governor, a geologist (R. A. Farquharson) was appointed for one year in the first instance, work actually being commenced in 1923. The survey was intended to be restricted to areas which would be accessible for commercial operations, but within a few years the Department was merged with that of agriculture, Mr. Farquharson acting both as Director of Agriculture and Geologist. Thus little, and in some years no time, was available for proper geological and mineralogical work. There has been no official geologist since 1934.

Private Investigations

Private prospecting has played an important part in the examination of the mineral resources of Somaliland, notably during the survey of their 100,000 sq. km. concession (by 100,000 km. of traversing) by the Somaliland Petroleum Co. in 1928-30. At the same time this company checked a considerable part of the area covered by a geological map made by the Anglo-Persian Oil Co's expedition in 1920-21. Although these concessions were prospected for oil, it is safe to assume that as the surveys were carried out on a

fairly detailed scale by trained geologists, no highly mineralised areas are likely to have been overlooked.

Geological Maps and Economic Geology

As a result of the work of the Somaliland Petroleum Co. and the previous concessionaires, a geological report together with a map on the scale of 1 : 1,000,000 of the larger part of the country has been compiled and published. In addition, private efforts have been made to prospect for and develop deposits of mica. A number of other economic minerals are known to occur in British Somaliland, but none of them is worked. Salt is produced from sea water by solar evaporation, and phosphatic guano was worked at one time.

Water supply is a very important question in Somaliland and a number of grants from the Colonial Development Fund towards the cost of boring have been made.

Zanzibar

The islands of Zanzibar (640 sq. miles) and Pemba (380 sq. miles) constituting the Zanzibar Protectorate are largely composed of coral and coral limestones as well as sands and argillaceous sediments overlying a decomposed crystalline basal complex. The coral and coral limestones provide rock for building and road making as well as for lime. A brief geological examination of the Protectorate was carried out in 1921 by E. J. Wayland, Director of the Geological Survey, Uganda, in connection with water supply, brick, cement and tile-making problems in the islands.

A detailed survey of the Zanzibar Protectorate was made in 1925 by G. M. Stockley, and the whole area was mapped on a scale of 1 in. to 1 mile. As a result of this survey, the hydrology of the Protectorate was worked out in detail and the water-supply problems solved. Building and road-making materials were also examined as were the clays, possibly suitable for brick making, which occur on Pemba. A number of other minerals were also closely investigated, but in no case was anything of economic interest discovered ; it was concluded that " mineralogically the Protectorate is poor."

Two very comprehensive reports were produced accompanied by uncoloured geological maps. That of the whole Protectorate is on a scale of approximately 1 in. to 21 $\frac{1}{2}$ miles, and the detailed maps of Zanzibar and Pemba are on a scale of 1 in. to 2 miles.

The geology as well as the economic mineral possibilities of the Protectorate have been thoroughly and adequately examined.

SOUTH AFRICA—HIGH COMMISSION TERRITORIES

Basutoland

Basutoland, with an area 11,716 sq. miles, is entirely a native reserve. No official geological survey exists, but some reconnaissance work has been done in recent years. In 1936, F. A. Venter, a Government Geologist of the Union of South Africa, did one

month's reconnaissance work for purposes of the ecological survey, covering about 1,000 sq. miles in the north and north-east parts of the country. In 1938 G. M. Stockley was seconded from the Tanganyika Geological Survey to make a reconnaissance geological survey of the whole territory on behalf of the Colonial Office. The work was expected to take at least a year and cost £1,560. A general account of this work is published in the *Geological Magazine*, December 1940, but no mention is made of economic possibilities. The official report is not available. No minerals are produced, but coal is reported to occur in the Mohales Hoek district.

Bechuanaland

Bechuanaland, with an area of 275,000 sq. miles, is the fourth largest colonial territory, but it has no official Geological Survey Department. More than three-quarters of the territory is covered with Kalahari Sands in which no economic minerals are likely to exist, and being 40 to 50 ft. in thickness and even 200 ft. thick in places, effectively conceal the older rocks in which economic minerals may occur. The following summarises the more important geological work carried out in the Protectorate.

Tati Area.—The 2,000 sq. miles of the Tati Concession may be considered as known, gold having been mined there since 1866, but there is no recent comprehensive report on the district. This is the only producing mineral area in the Protectorate, the value of production (gold and a little silver) being: 1938, £133,261; 1939, £132,968; 1940, £137,327.

Kalahari Reconnaissance Survey.—In 1925 Dr. A. L. du Toit, of the Union Geological Survey, made a 4 months' reconnaissance of the Chobe and N'gamiland Districts with a view to examining irrigation possibilities. *The Report of the Kalahari Reconnaissance Survey, 1925*, is published by the South African Department of Irrigation.

Walvis Bay Railway Survey.—In 1931 A. M. MacGregor (of the Geological Survey of Southern Rhodesia) made a geological survey of the proposed railway route which crosses the territory for 500 miles from the north-east to the western boundary, and a *Report on the Rhodesia—Walvis Bay Reconnaissance Survey*, by J. L. S. Jaffares presented to the Southern Rhodesia Legislative Assembly, was published in 1932.

British South Africa Co's Mineral Area.—This Company owns the mineral rights in the Gaberones and Tuli blocks (1,830 sq. miles) and has preferential but not exclusive mineral rights over very wide areas. In 1932 the Company agreed to prospect areas in the Bamangwato Reserve (39,000 sq. miles), Bakwena Reserve (15,000 sq. miles), and the Gaberones and Tuli blocks, a total area of 55,830 sq. miles, all in the eastern part of the country. On their behalf geologists of the Anglo American Corporation surveyed and prospected a total of 8,001 sq. miles, but in 1934 the work was abandoned.

as no economic minerals had been discovered and the areas were considered unpromising. No maps or reports of this work have been published.

Water Resources Survey.—In 1943 E. J. Wayland, formerly Director of the Geological Survey of Uganda, was appointed to undertake a survey of the water resources of the Protectorate. It is expected that the survey will take about three years.

In addition to gold, which is worked in the Tati area, copper, lead, coal and asbestos deposits are known to occur in Bechuanaland.

Swaziland

Swaziland covers an area of 6,705 sq. miles, one-third of which is native owned. Prior to the very recent appointment of a Government Geologist, a certain amount of geological information had been accumulated by geologists from the Union of South Africa. The Barberton (Transvaal) mineral area has been followed into Swaziland, the Swaziland coalfields have been roughly demarcated and the tinfields are known in general outline. The geological map sheet 68 of the Union of South Africa (scale $2\frac{1}{2}$ miles to 1 in.), published in 1931, includes some 470 sq. miles of South Western Swaziland, and a map of an adjoining area of 100 sq. miles around Kubuta on a scale of 1 mile to 1 inch was published in 1938.

A Government Geologist, H. J. R. Way, was appointed in May 1942 to make a preliminary geological survey with the primary object of reporting on existing mineral deposits and assessing the potentialities of the remainder of the country, funds being provided for an estimated period of two years. A progress report on the work to the end of 1942 has been published which mentions that reports on tungsten, corundum and tin deposits have been prepared, and that it is hoped in time to produce a provisional geological map of the country. Unfortunately the topographical maps available are inadequate for detailed work.

Tin and gold have been mined on a small scale for many years, but since the opening of the Havelock asbestos mine in 1939 mining has become of major importance. The latest statistics of mineral production are as follows :

	1938. £'000.	1939. £'000.	1940. £'000.
Asbestos	—	95,903	436,546
Tin	33,129	36,528	37,812
Gold	9,035	7,314	8,226

Among the minerals known to exist but not worked before the war are coal, scheelite and corundum. Development of mining is hindered somewhat by the confusion which exists regarding the ownership of mineral rights. Some 2,475 sq. miles of the territory are open to public prospecting.

MEDITERRANEAN

Cyprus

Reports by Professor Gaudry, of Paris, published in 1862, and by Bellamy and Jukes-Brown in 1905, established the outlines of the geology of the island of Cyprus, which occupies an area of 3,572 sq. miles. At the request of the Colonial Office, Professor C. G. Cullis and A. B. Edge spent 8 weeks in Cyprus in 1921 and reported on the cupriferous deposits. Their report (1922) gives a general account of the island, and contains a geological map (mainly after Bellamy) on a scale of 1 inch to $5\frac{1}{2}$ miles.

Mining is the principal industry after agriculture, and minerals account for 60 per cent. of the value of exports. The value of mineral exports amounted in 1938 to £1,428,000 of which copper concentrates constituted about one-half and cupriferous pyrites about one-third.

A considerable amount of private prospecting has been done in the metalliferous areas, and in 1938 a careful geological and topographical survey was in progress in an area covered by an oil exploration licence. There is a Government Inspector of Mines, but no official geologist. In view of the small area of Cyprus, geological investigations call for a mining geologist rather than a geological survey on the lines of the large colonies.

Water Supply

Water supply problems have always been important in Cyprus and several water engineers and geologists have visited the island from time to time, but the provision of adequate supplies requires constant maintenance and conservation work as well as the development of additional sources of supply. Dr. C. Raeburn was seconded from the Geological Survey of Nigeria to become water engineer in Cyprus in 1937, and in 1939 the Water Supply and Irrigation Department was set up under his direction. With the aid of grants from the Colonial Development Fund the existing situation has been examined and a considerable amount of prospecting work has been done, including a successful geophysical survey of certain areas by electrical resistivity methods followed by check boring. The war and lack of funds have delayed the intensive construction schemes proposed, but a Government subsidised scheme for providing bore-holes on private lands has given good results.

Palestine and Transjordan

The area of Palestine is 10,100 sq. miles, and the Government employed G. S. Blake as Geological Adviser almost continuously since the Mandate was established in 1922. The following official reports have been issued : *Geology and Water Resources of Palestine* (1928) ; *Mineral Resources of Palestine and Trans-Jordan* (1930) ; *Stratigraphy of Palestine and its Building Stones* (1935). By the end of 1939 the Survey Department had prepared (but not published)

10 geological maps on a scale of 1:100,000 (each covering 2,500 sq. km. or 965 sq. miles). These cover practically the whole of Palestine as far south as Gaza, i.e. half the area of Palestine, including all the settled areas. A general geological map of this area, scale 1:250,000, was issued in 1939.

Mineral resources in addition to the important Dead Sea potash deposits are primarily non-metalliferous, comprising important deposits of sulphur and gypsum, and possibly economic quantities of bitumen and petroleum. A fair amount of private prospecting has been done in certain areas.

The area of Transjordan is about 35,000 sq. miles, and geological investigations up to 1939 are summarised in a Transjordan Government report on water resources, geology, soils and minerals. The principal work done has been a hydrographic survey, started in 1937, and the investigations of Blake, whose report on mineral resources was published in 1930.

A geological outline map on a scale of 1:1,000,000 was compiled in 1939 on the basis of Blake's earlier work.

Important phosphate deposits are now being worked, and there are indications suggesting that appreciable quantities of petroleum may occur. There are considerable areas of Archaean and igneous rocks in which metalliferous deposits may exist.

EASTERN DEPENDENCIES

Ceylon

The total area of Ceylon is 25,332 sq miles. A Mineral Survey was established with a small staff in 1903 on the recommendation of Professor W. R. Dunstan, then Director of the Imperial Institute. This plan was adopted as the only feasible alternative to a complete geological survey, and it had as its object the examination of the occurrences and possibilities of developing the economic minerals of Ceylon. The laboratory work in connection with the Survey, which continued until 1910, was carried out at the Imperial Institute. In 1922 J. S. Coates was appointed Government Mineralogist, and in 1924 this office was combined with that of Salt Adviser, an arrangement which continued until his retirement in 1934. During this period only annual reports of the department were published and these contain only occasional references to minerals, but the field work for an outline geological survey of the island was completed in 1933 although no maps or geological reports appear to have been published.

Re-instituted in 1938 after a break of five years, the department is now known as the Department of Mineralogy and has its own laboratory and museum facilities. In 1940 the staff included one Government Mineralogist, one Inspector of Mines, and two Field Geologists.

The main aim of the present Department is the determination and mapping of the geological formations and structures of the

country preliminary to economic mineral investigations. Geological surveying and mapping of the island on a scale of 1 in. to 1 mile was commenced at the end of 1940 and several 1 in. sheets have been completed. A preliminary survey of certain areas in the Central Province, the North Central Province, and in the Eastern Province on a scale of 1 in. to 4 miles was also in progress in 1941. Altogether about one-third of the island has been surveyed and it is estimated (1943) that about nine or ten years more work is required to complete it.

The rôle of the mineral industry in the general economic structure of Ceylon may be gauged from the exports of the two principal minerals (other than salt). That of graphite was valued at £172,541 in 1937 whilst gemstones, in the absence of actual statistics, are estimated at a similar amount. This may be compared with the total of all Ceylon domestic exports of £23,264,833 in 1937.

The Department reported in 1940 that "the mineral industry of Ceylon has remained static and undeveloped for many decades and no expansion in the country's mineral production can be presaged till a comprehensive geological survey of the whole island has revealed the exact extent, distribution, and structural relations of the various economic rock, mineral and ore bodies. Conclusions can then be drawn as to the possibilities of mineral development."

British Malaya

The peninsula of British Malaya and the adjoining islands of the Straits Settlements have an area of 51,076 sq. miles, comprising the Federated Malay States, 27,540 sq. miles, Unfederated Malay States, 22,276 sq. miles, and the Straits Settlements, 1,260 sq. miles.

This small territory, just the size of England, has been the leading mineral producer in the Colonial Empire, yielding minerals to the total value of about £400,000,000 in the 50 years in which British firms have engaged in mining there.

Geological Survey

Geological literature on Malaya dates back for more than a century and the Geological Survey of the Federated Malay States has been in existence for 40 years although until 1912 it consisted of a single geologist, J. B. Scrivenor. The establishment of the Department during the period 1938-41 was one Director, one Mining Geologist, five Field Geologists and two Chemists. While primarily responsible only for the Federated Malay States the Survey also operates in the Unfederated States and Straits Settlements.

Two books by J. B. Scrivenor, *The Geology of Malaya* (1931) and *The Geology of Malayan Ore Deposits* (1928), give a general account of the country. A provisional geological map of Malaya on a scale of 12 miles to the inch was published in 1938. It includes several small unmapped areas, especially in Pahang and Trengganu.

Two reports with maps on a scale of 4 miles to 1 in. were published

in 1919 and 1922 and cover Negri Sembilan, Selangor, South Perak and the Dindings, a total area of about 7,750 sq. miles, i.e. one-quarter of the area of the Federated Malay States. In the 1930's a policy of making geological maps on the scale of 1 in. to 1 mile was adopted and the first of these maps appeared in 1937 and to date four sheets have been published. The sheets cover $\frac{1}{4}$ deg. latitude by $\frac{1}{2}$ deg. of longitude, about 294 sq. miles. Together with earlier maps of the Kinta tin areas on scale 1 $\frac{1}{2}$ in. to 1 mile, the detailed mapping has covered 2,058 sq. miles in Perak, 294 sq. miles in Pahang and 588 sq. miles in Selangor, a total of 2,940 sq. miles. This accounts for 10 per cent. of the area of the Federated Malay States. The annual report for 1940 has a key map showing the state of progress.

Before the war, field mapping was continuing in eastern Perak, western Pahang, Selangor, and on the east coast of Pahang, all of which are mining districts (tin and gold). No detailed mapping has been done in the Unfederated States, but maps of Malacca and Singapore have been published. The Geological Survey has also prepared regional maps of each of the four Federated States showing four categories: (a) Mining Land, (b) Potential Mining Areas, (c) Possible Mining Areas, (d) Areas not likely to be required for Mining.

The Geological Survey has examined and reported on practically all mineral deposits worked or discovered in both the Federated Malay States and the Unfederated States. Private companies (British, Chinese and Japanese) have done a considerable amount of prospecting, but little has been published concerning this except where mines have been opened up.

In his extensive *Report upon the Mining Industry of Malaya*, published in 1939, Sir Lewis L. Fermor has considered the activities of the Geological Survey Department in some detail. His observations cannot be adequately summarised here, and it must suffice to mention only two of his recommendations. Firstly, a greatly increased department is recommended, to be renamed the Geological Survey of Malaya and comprising one Director, two Superintending Geologists, nine Geologists, and two Chemists. Secondly, he stresses the need for a special investigation of the geology of the Alluvium, the most valuable formation in Malaya, primarily in relation to its tin content, but also from the aspect of its agricultural importance.

Mining

While tin dominates the mining industry of Malaya, the value of other mineral products, including iron ore, coal, tungsten ores, gold, bauxite and manganese ore, has grown to importance. Until 1937 Malaya was the leading mineral producer in the Colonial Empire, but in 1938, owing to the reduced output of tin, Northern Rhodesia attained that distinction. The following table summarises the mineral production from 1937 to 1939.

VALUE OF MINERAL PRODUCTION OF MALAYA.*

	1937. £ '000.	1938. £ '000.	1939. £ '000.
Tin Ore . . .	17,902	7,916	10,852
Iron Ore . . .	852	904	863
Coal . . .	387	377	284
Gold . . .	223	268	292
Tungsten Ore .	193	128	71
Other Minerals .	168	188	222
	<hr/>	<hr/>	<hr/>
	19,725	9,781	12,583

* Excluding Brunei and Christmas Island.

Dependencies in Borneo

No detailed geological survey has been made of the dependencies in Borneo. A general geological sketch map of the whole of Borneo (scale about 1 in. to 50 miles) and a map of the distribution of economic minerals, and one showing roughly the degree to which the geology of the different parts of the island is known (on the same scale) were made in 1892. The Dutch part of the island has been more closely examined, but it is said that this is not the reason that the mineral production of the Dutch part is larger than that of the British territories.

BRUNEI

Brunei, which is administered as one of the Unfederated Malay States, comprises 2,226 sq. miles. No geological survey of the country has been carried out. The mineral rights are reserved to the State and are the subject of special grants under the mining enactment.

STATE OF NORTH BORNEO

The area of the State of North Borneo is approximately 29,500 sq. miles and the present knowledge of the mineral deposits results from the work of the British Borneo Syndicate in 1900 and its successor, the British Borneo Exploration Co. in 1903. The Chartered Co. bought out the latter with the intention of proceeding further with the examination of the territory. Private prospecting is encouraged and a considerable search for gold has resulted. It has been said that there are few areas of comparable size to that of the Segama River district where there are such widespread indications of gold without a payable goldfield having been found. Considerable sums have been spent on examining particular mineral properties rather than on general geological work. This is particularly so in the case of oil, and in spite of the earlier lack of success on the part of the British Borneo Syndicate, the Dutch Colonial Petroleum Co. and the D'Arcy Exploration Co., the Anglo-Saxon Petroleum Co. decided on a complete examination of North Borneo for oil, but operations had to be suspended at the outbreak of war.

The British North Borneo (Chartered) Co. are of the opinion that the location of minerals and their exploitation will be done by Chinese with the encouragement and assistance of the Chartered Co. It is doubted whether, with the exception of coal, there are any mineral occurrences in quantities which would interest European companies although a considerable number of minerals have been found.

SARAWAK

No detailed geological survey of Sarawak has been made. It may be noted that H.M. Government have no rights of interference in the internal administration of this independent State and no licence or lease may be granted to any limited company registered outside Sarawak.

Oil is produced by Sarawak Oilfields Ltd. and is the principal item of export. Gold is also produced (19,643 oz. in 1937) and coal was formerly worked.

Aden Colony and Protectorate

Aden Colony, which has an area of about 80 sq. miles, is entirely volcanic. It is the largest producer of sea salt in the Colonial Empire, exports in 1937 being 364,000 tons valued at £253,000.

The Protectorate, which has an area of 112,000 sq. miles, appears to be practically unexamined. The most detailed investigation was 3½ months field work by O. H. Little of the Egyptian Geological Survey at the beginning of 1920. He covered about 1,700 sq. miles around Mukalla in the Hadhramaut and made a geological map of this district on a scale of 1:250,000. Lignites, oil shales, gypsum, and traces of bauxite, manganese ore, etc., were recorded.

In 1936 the Egyptian University of Cairo sent a scientific expedition to the Yemen and the Hadhramaut, which covered some 1,600 miles in about six months. One of the expedition's main aims was to work out certain problems connected with the geological history of the southern borders of the Red Sea, and it explored to the south and west of the Yemen plateau as well as in the interior of the Hadhramaut. No full report of this work appears yet to be available.

General knowledge of the geology of Arabia suggests that the Aden Protectorate consists largely of Eocene and Cretaceous sedimentary rocks, but with areas of older igneous rocks and crystalline schists.

WESTERN PACIFIC

Fiji

The Colony of Fiji consists of numerous islands having a total area of 7,055 sq. miles, of which no systematic geological survey appears to have been made. Many of the islands consist entirely

of volcanic or coral formations and seem unlikely to possess mineral wealth, but Vitilevu and Vanualevu contain a wide range of rocks and gold mining is established in both islands. Gold production only began in 1932 but the output increased rapidly and in 1940 was at the rate of more than £1,000,000 annually. The value of exports of gold and sugar are now roughly equal, and together account for 90 per cent. of Fiji's exports.

The nearest approach to official geological work is done by the Mines Section of the Department of Lands, Mines and Surveys, but its staff consists primarily of mining engineers. The gold mining companies have done a considerable amount of prospecting, and also manufacture lime for their own and general use.

WEST INDIES AND AMERICA

Jamaica

Jamaica, which covers an area of 4,450 sq. miles, of which 646 sq. miles consists of alluvium, marl and swamps, was surveyed geologically in the 1860's by J. G. Sawkins and an assistant as part of the West India Survey, and a map on the scale of $\frac{1}{4}$ in. to 1 mile was produced in 1865. As a result of this work an excellent comprehensive report of some 340 pages was published in 1869 dealing in considerable detail with the rocks and minerals of each individual parish.

By the appointment in the early 1920's of a geologist (Dr. Matley, later succeeded by Dr. Stockley), the Geological Survey of Jamaica was revived with the object of improving the water supply situation, and when this appointment was terminated in 1924 the retiring geologist pointed out the necessity for a Geological Survey in Jamaica and its usefulness to public works and agricultural activities on the island.

Sir Stopford Brunton, the eminent Canadian mining engineer, in a report made in 1922 on the geology and mining possibilities of Jamaica (based partly on the 1869 report and partly on his own observations) pointed out that the original survey was made "at a time when the science of geology as applied to mining was not properly appreciated." He also drew attention to the possible parallel between conditions in Jamaica and those in the highly mineralised neighbouring island of Cuba. He concluded that although "mining efforts have so far not met with success, the numerous indications of all sorts of minerals . . . would warrant the statement that mineral resources of this island . . . had not been given a fair trial."

In view of the recent interest in bauxite deposits in the island it is worthy of note that in the report of 1869 by J. G. Sawkins (p. 167) these deposits were described under the name of "red ferruginous earth" and the composition given as "principally a mixture of iron and alumina."

Trinidad and Tobago

Although Trinidad (1,864 sq. miles) and Tobago (116 sq. miles) constitute one of the smaller units of the Colonial Empire, in few countries is the mineral production of such prime importance. Trinidad is the leading producer of petroleum and asphalt in the Empire, output in 1938 being valued at £2,750,000, and exports of these products constituting 73 per cent. of the island's export trade.

Geological work in Trinidad commenced when, under the direction of the Geological Survey of Great Britain, G. P. Wall and J. G. Sawkins made a geological survey of the island between 1857 and 1859. H.M. Stationery Office published their report and map in 1860. The next episode took place when E. H. Cunningham Craig, who was Government geologist from 1904 to 1907, did detailed geological mapping, and in particular called attention to the petroleum possibilities of the island. His reports were published as Council Papers. An Inspector of Mines was also appointed in 1904 and reports of his department have been published annually up to 1938. A Government geologist (C. A. P. Southwell) was attached to this department between 1923 and 1926, when the post was abolished and this officer was put in charge of oil and gas conservation, later with the title Petroleum Technologist. In 1938 the establishment of the department comprised an Inspector of Mines and Petroleum Technologist, and two Assistant Petroleum Technologists.

The opening up of the oilfields began about 1908 and since then the geology of the southern half of the island has been thoroughly investigated by geologists employed by the oil companies. The northern mountain range of Trinidad and the island of Tobago, which are composed of metamorphic rocks, have not been investigated in the same detail as the oil-bearing regions, but they do not appear to contain mineral deposits of economic importance.

Although there are several scientific and economic papers on the geology of Trinidad, there has been no official Government publication on this subject in recent years and no geological maps appear to have been issued since 1905-7; nor does the important matter of water supply appear to have received official attention.

Windward and Leeward Islands

The Windward Islands cover a total area of 725 sq. miles and the Leewards about 500 sq. miles. The geology of some of these islands was examined by a Government Geologist in 1921, 1922 and 1923, as a result of which a number of reports on some of the islands was issued. The general conclusion reached was that the commercial development of minerals in the islands was unlikely although occurrences of economic minerals are known. A few materials for local use, such as pottery clay, salt and roadstone, are produced.

No geological maps of these islands appear to have been prepared.

Falkland Islands

The area of this group of two larger islands and about 200 smaller ones is about 4,618 sq. miles. A geological survey was carried out, under very adverse conditions of weather and travelling, by a single geologist, over a period of about 15 months in 1920-22. Mineral specimens had been received at the Imperial Institute from the Falkland Islands at various times and it was hoped that the survey might reveal deposits of economic importance, but this did not eventuate. An uncoloured geological map of the main islands on a scale of about 9.1 miles to the inch was produced.

British Honduras

The only official geological survey work carried out in British Honduras, which covers an area of 8,866 sq. miles, was that commenced in 1921 by L. H. Ower, the Government Geologist, but in view of the fact that economic minerals were not met with in commercial quantities the survey was abandoned in 1926.

At the time of this survey, there were no topographical maps sufficiently accurate even for a sketch geological map. The triangulation of the country was however commenced about the time of the cessation of geological work, and a small geological map on a scale of 1 : 1,000,000 was subsequently compiled by the Surveyor-General's Department from notes and surveys of the geologist. The information contained on this map is by no means detailed as it only shows the major geological divisions.

There has been a not inconsiderable amount of private geological investigation in British Honduras though this has been largely of an academic nature. In addition the study of the adjacent territory of Guatemala is said to be a valuable guide to geological conditions in British Honduras. On the other hand, however, the conditions in Mexico, particularly those relating to the occurrence of the oil there, do not obtain in Honduras.

The general geology of the country has therefore been outlined, and there seems relatively little possibility that mineralisation on any extensive scale has been overlooked. One or two minor areas have, however, not been prospected. According to an official report by Mr. Ower, the chances of obtaining petroleum in the country are not as remote as was originally supposed. In 1936 a number of small bituminous specimens were sent by the Governor of the Colony to the Imperial Institute for examination as a result of which, although no speculation as to their possibilities could be made, it was considered that some of the occurrences might be worth further sampling. It is not recorded in what connection this sampling originally arose, but apparently there were no subsequent developments.

Gold and tin have also been privately and officially prospected for without any notable success.

British Guiana

British Guiana, the only British Colony on the mainland of South America, covers an area of approximately 89,480 sq. miles. A number of important minerals are known to occur, and some of these are exploited commercially. The gold and diamond deposits are of great importance, and the bauxite deposits are among the largest, purest and most readily accessible in the world. Manganese deposits were discovered by the Geological Survey, kaolin occurs and is exploited, and building stones are quarried. There are vast reserves of potential water power; the Kaieteur Falls on the Potaro River are nearly five times as high as Niagara, and there are other utilisable falls in the country.

Geological Surveying

Early geological work in the colony was carried out by J. G. Sawkins and C. B. Brown under the direction of the Colonial Office, and a report accompanied by a map was published in 1875. From 1897 to 1905 a considerable amount of geological reconnaissance work, especially on the goldfields, was carried out by J. B. Harrison (Government Geologist) and H. I. Perkins (Acting Commissioner of Mines). Harrison then became Director of the Department of Science and Agriculture, and geological work was carried on partly by this department and partly by the Lands and Mines Department for some years, reports being produced on bauxite and on the occurrence of petroleum and pitch. In 1925 a Geological Branch, consisting of two geologists, was formed, and after having surveyed 900 sq. miles, chiefly of gold and diamond fields, it was closed down in 1929. The Geological Survey was formed under the Department of Lands and Mines in 1933, a loan of \$39,830 having been made from the Colonial Development Fund for carrying out an Economic Mineralogical and Geological Survey of the Bartica-Potaro-Tiboku area. A further grant of £22,000 was made in 1935 for the purpose of carrying out a geological survey of the Colony over a period of four years. The staff consisted of one Director and two Geologists until 1939, since when the Director has functioned alone.

Recently proposals have been put forward for the permanent establishment of a Geological Survey, and it is planned to extend the surveys into the upper Berbice and Courantyne, the upper Cuyuni and other remote areas.

Geological survey work in the country has been greatly hampered by lack of funds, by the lack of continuity, by the difficult nature of the country and by the inadequacy of topographical maps. When funds have been available it has gone forward bravely. Most of the work has been the examination of areas where gold was known or presumed to occur, and the Survey has materially assisted in raising the gold output of the country to a high level. As a result of the reliable information it has provided, mining companies have evinced considerable interest in the possibilities of large-scale development. Much of the field work has consisted in systematic

exploration by traverses often cut through forest where vision is restricted and underlying rocks obscured by alluvial and residual deposits so that geological boundaries are often conjectural. The department has produced 19 bulletins describing the areas examined. A deposit of manganese ore was discovered in the north-west district as a result of which an Exclusive Permission to examine the deposits was granted to the Bethlehem Steel Co. of the United States, but their examination resulted in the finding of too small a tonnage of good quality ore to warrant exploitation.

Private Investigations

Much detailed geological work has been done, especially on the bauxite deposits of British Guiana, by private concerns since 1914, but no reports on this work have been published. The companies concerned were the Demerara Bauxite Co. and the British and Colonial Bauxite Co., and it is estimated that at least £40,000 was spent in the Colony in 1938 by mining companies in the investigation of mineral resources. During 1939 a seismic survey of the Courantyne-Berbice area was carried out by the Central Mining and Investment Corporation Ltd. with a view to obtaining information prior to boring for oil in this area.

Geological Maps

The geological map of the country on a scale of 1:1,000,000 is based on the work of the older investigators and is periodically brought up to date. It is merely an outline map with the general geology sketched in and the latest issue appears to have been in 1924. Since the Geological Survey was formed in 1933 about 9,000 sq. miles of territory in the centre and north-west of the country has been mapped and surveyed on scales of 1:25,000 or 1:50,000.

ABSTRACTS AND NOTES

Obituary.—We have to record with deep regret the deaths of three members of our Consultative Committees, Mr. E. H. Clifford, the well-known mining engineer, and two eminent metallurgists, Mr. J. L. F. Vogel and Dr. W. H. Hatfield.

E. H. Clifford.—Edward Herbert Clifford, A.R.S.M., M.I.M.M., died at Cobham, Surrey, on October 11th, at the age of 67. After receiving his preliminary education at St. Paul's School in London, Mr. Clifford went first to the Royal School of Mines and later to the Bergakademie in Freiburg for his professional training. Commencing his mining career on the Witwatersrand in 1897, he had become by 1914 consulting engineer in Johannesburg to the Central Mining-Rand Mines or Corner House Group.

During the war of 1914-18 Mr. Clifford came home and took up a position with the Ministry of Munitions under Sir Lionel Phillips, to which department he eventually became Chief Technical Adviser, afterwards returning to his appointment with the Corner House group in South Africa. In 1926 he became consulting mining engineer in London to the British South Africa Company, which was his last professional appointment. During the present war he was co-opted on to the Departmental Committee set up by the Ministry of Supply to stimulate the production of non-ferrous metals in this country.

Mr. Clifford's intimate association with mining was by no means confined to the practical side for he had long taken a keen interest in both its educational and sociological aspects. He was a member of the Governing Body of the Imperial College and in 1941-42 was elected President of the Institution of Mining and Metallurgy. The Imperial Institute was also fortunate in obtaining the benefit of his wide experience as a member of the Advisory Committee on Gold, Silver, etc., from 1934 to 1936, and subsequently on the Base Metals Committee.

J. L. F. Vogel.—Julius L. F. Vogel, a pioneer of tungsten manufacture in Britain and for nearly 30 years General Manager of High Speed Steel Alloys, Ltd., of Widnes, died on August 30th, at the age of 70. He was born in New Zealand, the youngest son of the late Sir Julius Vogel, K.C.M.G., a former Premier of that Dominion. Coming to England as a boy he was educated at Charterhouse and then took courses at the Finsbury Technical College while apprenticed with a firm of electrical engineers. His business career began in 1894 in association with Dr. O. J. Steinhart as a consulting chemical engineer, and together in 1901 they commenced the manufacture of tungsten powder in a small factory in London. This was the first tungsten to be produced on an industrial scale in Britain, and although the venture was financially a failure, the experience gained proved of great value when in 1914 Mr. Vogel was given the urgent task of designing and speedily bringing into production the tungsten works at Widnes. He continued as manager of High Speed Steel Alloys, Ltd., for the remainder of his life and became a recognised authority on ferro-alloys.

Mr. Vogel had been a member of the Imperial Institute Consultative Committee on Ferro-Alloys for many years, having previously served on the Tin and Tungsten Committee of the Imperial Mineral Resources Bureau. He was well known in professional circles, being a member of the Institutions of Electrical Engineers, Chemical Engineers, and Mining and Metallurgy, and travelled widely, his professional duties taking him to the metallurgical centres of Europe and to his company's tungsten mine in Burma.

Dr. W. H. Hatfield.—William Herbert Hatfield, F.R.S., who died on October 17th at the age of 61, was one of the most distinguished and successful metallurgists of his generation. He was born, educated and died at Sheffield, and most of his life's work was carried out in and around that famous centre of steel manufacture. On leaving the University he commenced his industrial career in the laboratories of Sir Henry Bessemer & Co., Ltd., later becoming metallurgist to J. Crowley & Co., Ltd., Wincobank, where he quickly rose to the position of manager and a director of the firm. In 1916 he joined the Brown-Firth laboratories and it was largely owing to his ability and energy that this organisation was raised to its present important position. Here it was that he carried out the researches with which, more than all his other achievements, his name will probably be chiefly remembered—his epoch-making work on the so-called "stainless" steels and heat-resisting chrome-nickel steels. At the time of his death he was a director of Thos. Firth & John Brown, Ltd., and of Firth-Vickers Stainless Steels, Ltd.

Dr. Hatfield was not only a brilliant research worker, but also an entertaining lecturer and a lover of debate and controversy, and was the author of two text-books and of many original papers, including at least twenty presented to the Iron and Steel Institute, of which he was a member for 40 years. He was a D.Met. of Sheffield University, a Member of the Institution of Chemical Engineers, of the Institution of Mechanical Engineers and of the Institute of Patentees, and a Fellow of the Chemical Society. In 1935 he was elected a Fellow of the Royal Society, and in the course of his career he was the recipient of many other honours, including the Mappin Medal, the Crompton Medal, and the Bessemer Gold Medal. During the present war Dr. Hatfield devoted himself actively to the work of the research committees organised jointly by the Iron and Steel Institute and the British Iron and Steel Federation, and to that of numerous other research committees, especially the Technical Advisory Committee on Special and Alloy Steels (Iron and Steel Control), of which he was chairman. In this latter office he was largely instrumental in reducing the number of different steels supplied for Service requirements with consequent increase in productive capacity and efficiency. Among the very many other committees of which he was a member was the Consultative Committee on Iron and Ferro Alloys of this Institute, to which his knowledge and experience were of immense value, particularly in connection with the compilation of mineral monographs dealing with ferro-alloy metals.

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Tin Mining in Nigeria. By W. E. Sinclair. *S. Afr. Min. Engng. J.*, 1943, **54**, No. 2637, 503, 505, 507.

The Longhorn Tin Smelter, Texas. By C. B. Henderson. *Min. and Metall.*, 1943, **24**, No. 436, 196-200.

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Antimony and Tungsten: Position of Supplies. *Times Tr. and Engng.*, 1943, **53**, No. 954, 10.

Detection of Scheelite by Ultra-Violet Radiation. By D. C. McLaren. *Canad. Min. J.*, 1943, **64**, No. 8, 494-500.

The Recovery of Scheelite Concentrate at Hollinger Tungsten Mill [Ontario] during 1942. By J. Blackshaw. *Canad. Min. Metall. Bull.*, 1943, No. 375, 226-256.

Scheelite, near Falcon Lake, Manitoba. By J. D. Bateman. *Pre-Cambrian*, 1943, **16**, No. 8, 4-7, 13.

Tungsten Deposits of British Columbia. By J. S. Stevenson. *Bull. No. 10 (Revised), B.C. Dep. Mines*. Pp. 169, $10\frac{1}{2} \times 7\frac{1}{4}$, and maps. (Victoria, B.C.: King's Printer, 1943.)

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Tungsten Deposits of Southern Kiangsi, China. By Ke-Chin Hsu. *Econ. Geol.*, 1943, **38**, No. 6, 431-474.

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Amosite in South Africa. By W. E. Sinclair. *Min. Mag., Lond.*, 1943, **69**, No. 4, 210-215.

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Boron in Hot Springs at Tokaanu, Lake Taupo. By J. Healy. *N.Z. J. Sci. Tech.*, 1942, **24**, No. 1B, 1-17.

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The Natural History of Gravel. Part 2. Distribution of Gravel in England and Wales. By H. B. Milner. *Cement, Lime and Grav.*, 1943, **18**, No. 2, 58-63. XXVII. Introduction, Anglesey. No. 3, 75-82. XXVIII. Bedfordshire. No. 4, 104-112. XXIX. Berkshire.

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Cone-in-Cone and Ring Fracture in Coal from Greymouth, New Zealand. By M. Gage. *N.Z. J. Sci. Tech.*, 1942, 24, No. 2B, 86-98.

Carbonisation of Bevier-Bed Coal from Kansas and Production of Blue Water Gas from the Resulting Coke. By W. W. Odell. *Rep. Invest.* No. 3671, *U.S. Bur. Mines*. Pp. 21, $10\frac{1}{2} \times 8$. (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.)

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Carbonising Properties and Petrographic Composition of No. 2 Bed Coal from Bartoy Mine and No. 5 Bed Coal from Wilkeson-Miller Mine, Wilkeson, Pierce County, Washington. By J. D. Davis, D. A. Reynolds, G. C. Sprunk, C. R. Holmes and J. T. McCartney. *Tech. Pap.* No. 649, *U.S. Bur. Mines*. Pp. 46, 9×6 . (Washington, D.C.: Superintendent of Documents, Government Printing Office, 1942.) Price 10 cents.

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Artificial Production of Diamonds. By C. H. Desch. *Nature*, 1943, **152**, No. 3849, 148-149.

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Mining Fluorspar by Square-set Stoping. *Iron Coal Tr. Rev.*, 1943, **147**, No. 3945, 541-543. A description of mining operations at the King Mine, Masson, Matlock, Derbyshire.

Fluorspar: a Vital Mineral for War Purposes. By E. Hinchliffe. *Mine and Quarry Engng.*, 1943, **8**, No. 10, 229-230.

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Graphite: Methods of Concentration and its Uses. *Min. Mag., Lond.*, 1943, **69**, No. 2, 77-79. Abstract of a report from the *Bonython Laboratory New Series*, No. 138, *Austr. C.S.I.R.*, No. 124.

Concentration of Flake Graphite Ores. By D. C. McLaren. *Min. Mag., Lond.*, 1943, **69**, No. 2, 73-76. An exposition of the principles involved and usual technique.

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Carbon Black and Lampblack. By M. Schofield. *Paint Manuf.*, 1943, **13**, No. 10, 233-235.

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Orissa: Report on the Administration of the Salt Department during the year 1941-1942. Pp. 9, 13 x 8½. (Cuttack: Superintendent, Orissa Government Press, 1942.) Price 6d.

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Talc

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Domestic Talc. By T. A. Klinefelter. *Bull. Amer. Ceram. Soc., 1943, 22*, No. 7, 225-227.

Western Talc. By W. W. Roff. *Bull. Amer. Ceram. Soc., 1943, 22*, No. 8, 292-295. Current information of talc now being produced in California, Nevada and Montana.

EXHIBITION GALLERIES, FILM LIBRARY AND CINEMA

NOTES

Exhibition Galleries.—The six months which have elapsed since these notes last appeared (this BULLETIN, 1943, 41, 145) have been marked by greatly increased attendances in the Galleries both by members of the general public and by organised parties from schools and similar institutions. Some impression of these increases may be gained by the following analysis of organised parties; for comparison the corresponding figures for the preceding six months are given in brackets.

School and youth organisations, 79 parties (18 parties).

Colonial and foreign evacuees, 36 parties (12 parties).

United Kingdom, Dominion, Indian, Colonial and Allied troops, 21 parties (15 parties).

Learned and Empire societies, 11 parties (4 parties).

Government entomologists, 5 parties (4 parties).

Apart from these increases in the number of visitors, it has been gratifying to note the enhanced interest which they appear to show. This is evidenced by a more intensive examination of the exhibits which is now being made, by the number of questions asked, and by a greatly increased demand for the services of guide lecturers. Indeed, at times, this latter service has only been maintained at the expense of other duties.

Additional evidence of an increasing public interest in Empire affairs is shown by a demand which has now arisen for the Exhibition Galleries to be open also in the mornings. Owing to depletion of staff (now intensified by the loss of two further members), and to the morning preoccupations of those ladies who have so generously volunteered to act as official custodians, full day opening is not at present possible; but this demand for morning facilities to visit the Galleries has been largely met by permitting duly authenticated visitors and school parties to make self-conducted tours of the Galleries at any time during office hours by pre-arrangement with the General Secretary.

Among distinguished visitors and officials who have been received by the Director and conducted on a tour of the Galleries, or on a visit to a particular Court, are the following:

On August 10, Sir Bernard Bourdillon, G.C.M.G., K.B.E., ex-Governor and Commander-in-Chief, Nigeria.

On August 11, Sir Charles Jeffries, K.C.M.G., O.B.E., Assistant Under-Secretary of State, Colonial Office.

On September 8, Mr. H. R. R. Blood, C.M.G., Governor and Commander-in-Chief, Gambia.

On September 8, Sir Hubert Stevenson, K.C.M.G., O.B.E., M.C., Governor, Sierra Leone.

On September 30, Sir Theodore Adams, C.M.G., Chief Commissioner, Northern Provinces, Nigeria.

On October 6, H.E. the Rt. Hon. Sir Reginald Dorman-Smith, G.B.E., Governor of Burma, accompanied by his suite.

Apart from their internal educational work, the Exhibition Galleries, during the period under review, have rendered considerable assistance to a number of organisations connected directly with the war effort or engaged in various forms of Empire publicity.

To the Education Headquarters of the Aldershot Command have been lent comprehensive collections of exhibits and photographs illustrating the life, scenery, natural resources and local arts and crafts of India and of West Africa ; and also series of maps and photographs covering the Dominions, India and the Colonial Empire. These have proved of great service in the scheme of Empire education instituted for troops passing through this command.

To the "Colonial Partnership" Exhibition organised by the Ministry of Information in association with the Colonial Office, now touring the country, a considerable amount of exhibition material has been supplied.

Other official organisations which have been supplied with specimens or photographs are the Ministry of Information, the Ministry of Supply and the British Broadcasting Corporation, while photographs have been lent to the *Crown Colonist*, *Our Empire* and the *P.D. Review*. Photographs have also been lent to a number of industrial concerns handling Empire raw materials and to publishers issuing various Empire books and publications.

Retirement of Mr. H. Spooner.—On July 4, 1943, Mr. H. Spooner retired under the age limit from the position of Curator of the Exhibition Galleries of the Imperial Institute. He joined the staff of the Galleries as one of the Technical Superintendents in 1906, succeeding to the post vacated by the late E. H. Wilson, the well-known botanical explorer of Western China.

During the war of 1914-1918, when the Galleries were occupied by War Departments, Mr. Spooner was attached to the Intelligence Section of the Institute, then known as the Technical Information Bureau, and did valuable work in connection with the numerous inquiries concerned with the war effort that were being received at that time. In 1920 he took over charge of the Exhibition Galleries, being given the title of Curator in 1926 when the Institute was reorganised.

Mr. Spooner was a frequent and valued contributor to the BULLETIN OF THE IMPERIAL INSTITUTE. Articles for which he was wholly or mainly responsible, among many others, were those on coconuts (1912), some common spices (1913), pineapple (1916), peas and beans of commerce (1917), bananas (1924 and 1925), groundnuts (1925), ginger (1926), and castor seeds (1930).

Before coming to the Institute Mr. Spooner had been engaged in scientific horticulture, receiving his early training at the Essex Technical Laboratories, Chelmsford (later the East Anglian Agricultural Institute) whence he proceeded by scholarship to the Royal Horticultural Society's Gardens at Chiswick. From there he passed to the Royal Botanic Gardens, Kew, and subsequently, in 1901, entered the firm of Messrs. James Veitch & Sons, Ltd., of Chelsea, becoming personal assistant and private secretary to Sir Harry Veitch.

This experience in practical horticulture, combined as it was with both pure and economic botany, together with his natural bent towards artistic subjects, formed an ideal training for his work at the Institute. Under three successive Directors he was responsible for putting into effect the changes in the arrangement of the Galleries which were introduced during this period and much of the credit for the excellent display now to be found there must be attributed to him. Mr. Spooner will be greatly missed, not only by his colleagues at the Institute, but also by the numerous officials and visitors with whom his work brought him into contact.

New Exhibits.—The difficulty in obtaining materials for new exhibits, mentioned in our last Notes, continues to operate and will probably do so for the duration of the war, but the following improvements have already been carried out or are in process of completion.

In the British Somaliland Court, to the relief model map have been added the main lines of advance of our troops during the Abyssinian Campaigns, and the return route of the Emperor of Abyssinia to his capital. A brief description of the campaign has also been added.

In the Southern Rhodesia Court, a further set of photographs showing the styles of architecture adopted for modern official buildings and schools in Southern Rhodesia, prepared from negatives kindly loaned by the High Commissioner for Southern Rhodesia in London, have been combined with the set previously received and the whole displayed on a screen under the title of "Some Modern Public Buildings in Southern Rhodesia."

In the Malta Court was displayed for a period the silk mosaic presented by the Royal Society of Saint George to the island of Malta to commemorate the colony's heroic resistance. It aroused considerable interest and for those who were unable to see this

beautiful piece of work the following official description may be of interest :

*“ Description of Panel of St George
presented by
The Royal Society of St. George
to the
Island of Malta*

“ In this symbolical panel of silk mosaic, the spirit and heroism of those young fighters of the Royal Air Force, who gave their lives that Malta might remain free, have become one in guardianship of the island with its own guardian St. George. Just as their wings protected it from enemy bombers, so an R.A.F. pilot's wings span across the word 'Malta,' with its cross of the Knights Hospitallers beneath it on the right hand side of the panel. On the left, hanging from the golden strap on which 'Malta' is embroidered, and backed by a long scroll made of the blue ribbon of the 'George Cross,' is the unsheathed sword of St. George (that same sword that the men of the First Army in Africa have as a shoulder 'flash').

“ All these symbols are grouped against the silvery grey colour of an aeroplane wing with its 'target' of red, white and blue placed behind St. George's head to form the perfect halo for a saint who was also a fighter. Under his traditional chain-mail and white surcoat with its red cross and golden belt, a glimpse of Air Force blue can be seen at wrist and neck in the 'haqueton' or padded garment worn under all chain-mail.

“ He stands in front of a bordered velvet-brocaded background, with a design of semi-heraldic birds, which were woven in Persia in the sixteenth century and used here to symbolise the ancient as well as the modern importance of Malta. The panel was designed and carried out in 1943 by Mary Ireland, a life member of the Royal Society of St. George, England.”

For the Canadian Court funds have been provided by the Canadian Government for the construction of a large relief model map of the Dominion. The map is in active preparation and delivery is expected shortly.

For the British Guiana Court, funds for the execution of the statuette of Sir Walter Raleigh, described in the last issue of these Notes (this BULLETIN, 1943, 41, 148), have now been generously provided by the Limmer and Trinidad Lake Asphalt Company, Ltd., and this act of generosity is acknowledged on a bronze plaque which has been affixed to the pedestal.

In the Australian Court the exhibit of dairy products has been temporarily improved by the addition of sample tins of various brands of condensed milk provided through the kind offices of the Trade Commissioner for Australia in London. Plans for a completely new story exhibit of Australian dairy products have been

prepared and the scheme will be carried out as soon as conditions permit.

To bring the Indian Court into line with other Courts in the Galleries a seat for the use of visitors has been constructed of Indian woods in the Imperial Institute workshops and installed in the Court. The woods employed include teak (*Tectona grandis*), toon (*Cedrela toona*), walnut (*Juglans regia*), sissoo (*Dalbergia sissoo*), poon (*Calophyllum tomentosum*) and Indian coral or mochi wood (*Erythrina indica*). [This paragraph is in substitution for that published in this BULLETIN, 1943, 41, 147.]

Empire Lantern Slide Library.—During the six months April-September 1943 covered by this report 24,120 lantern slides have been issued to schools and lecturers in the United Kingdom. The details are shown below :

	April.	May.	June.	July.	August.	September.
United Kingdom . . .	300	240	120	120	240	300
Australia . . .	60	180	120	240	—	480
Canada . . .	180	360	480	300	240	360
New Zealand . . .	300	180	300	660	60	300
Union of South Africa . . .	—	240	480	180	60	180
India . . .	60	180	660	600	240	900
Burma . . .	480	600	240	240	240	120
Colonial Empire . . .	1,740	2,880	2,160	1,200	420	1,500
Products . . .	60	120	—	60	120	300
General Tours . . .	480	240	120	180	60	120
History . . .	—	240	240	60	—	—
	<hr/> 3,660	<hr/> 5,460	<hr/> 4,920	<hr/> 3,840	<hr/> 1,680	<hr/> 4,560

Six new Picture Talks have been printed, as described below :

A Picture Talk by Sir Harry Luke covers the numerous island groups in the Pacific which come under the administrative control of the Colonial Office : Fiji, Gilbert and Ellice Islands, Solomon Islands, Tonga, New Hebrides, Pitcairn Island. Sir Harry Luke describes the customs and way of life of the Polynesians, the Micronesians and the Melanesians—the differences between their races, the methods of administration and government and the social and educational amenities available to them.

Professor John Coatman's Picture Talk on "The Character and Growth of the British Empire" gives a brief historical survey indicating how the constituent countries joined the Commonwealth—the great diversity of races, creeds and legislatures to be found within it, and some of the problems which have been solved on the way to self-government for the Dominions.

Mr. F. H. Andrews' talk on "Craftsmanship in India" explains the ancient crafts of Indian potters, weavers, dyers, embroiderers, coppersmiths, the workers in precious metals, sandalwood and ivory, the woodworkers and sculptors.

The remaining three talks on India are by Mr. R. D. Anstead. "The Madras Presidency" and "South India and its Temples" illustrate the religious orders, processions and architecture of Southern India, the scenery of the Nilgiri Hills, the town bazaars and life of the people. "India's Summer Crops" is an account of the cultivation of rice, millet, maize, jute, tobacco and cashew nuts, the irrigation of the fields, harvesting of the crops, their preparation and transport to market and shipment overseas.

Central Film Library.—The increase in circulation of films from the Library reported in previous BULLETINS continues and shows no sign of abating. During the twelve months ended August 31, 1943, the figures, as compared with the previous twelve months, were as follows :

	1942-43.	1941-42.
Empire.	35,307	34,048
G.P.O.	7,184	6,393
Ministry of Information	63,836	42,413
	<hr/>	<hr/>
	106,327	82,854

In the first two months, September and October, of the year 1943-44, 18,000 films were despatched from the three sections of the Library. These figures again are higher than the corresponding months in 1942-43.

On September 1, 1943, the strength of the Library in subjects and prints was as follows ; it should be explained that the 35 mm. subjects are frequently duplicated in 16 mm. and *vice versa*, so that the total number of subjects does not usually represent the total under the 35 mm. and 16 mm. columns, and that the larger number of 16 mm. prints represents an attempt to meet the demands from schools :

	No. of Subjects.			No. of Prints.	
	35 mm.	16 mm.	Total.	35 mm.	16 mm.
British Empire	7	18	18	8	157
Canada	38	83	89	58	424
Australia	4	14	15	5	98
New Zealand	6	8	11	6	48
Union of South Africa	11	24	31	17	102
Southern Rhodesia	1	—	1	1	—
India	3	15	15	6	147
Burma	2	4	4	4	16
Colonial Empire	28	44	61	34	225
	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
Total, Overseas Empire	100	210	245	139	1,217
	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
United Kingdom	9	97	97	10	579
G.P.O.	48	52	55	150	474
Ministry of Information	348	367	367	1,392	8,300
	<hr/>	<hr/>	<hr/>	<hr/>	<hr/>
GRAND TOTAL	505	726	764	1,691	10,570

From these totals it will be seen that some parts of the Empire are not as well represented as others. Every effort that is possible during wartime is being made to amend this position.

The Ministry of Information section contains 37 films about the countries of the Empire and 44 about Allied countries ; the rest relate to the United Kingdom.

It will be noted from the table that a few of the films in the Library are only available in either 35 mm. or 16 mm. ; most of the films are available in both sizes.

Empire Lectures to Schools.—The last review of the Empire Lecture Scheme covered a period of eight months to April 30, 1943. The present review covers the last four months of the 1942-43 lecture season which closed on August 31, 1943, and discusses the progress during 1942-43 and the prospects for 1943-44.

The substantial expansion of the scheme, which had been noted, was maintained during the closing months of the 1942-43 season. During the four months ended August 31, 1943, 537 lectures were delivered to audiences aggregating 82,738 children. During the same period a year earlier the figures were 264 and 45,437 respectively.

The statistics for the two seasons 1941-42 and 1942-43 are as follows :

	1941-42.	1942-43.
Number of lectures delivered	768	1,476
Aggregate audiences	126,098	241,648
Number of lectures illustrated by slides or films	557	1,201
Number of other lectures	211	275
Lectures on Canada	100	116
Australia	108	198
New Zealand	23	58
Union of South Africa	68	88
India	135	162
Colonial and other Territories	232	690
General Empire	102	164
Audiences—Northern Counties	40,627	66,388
Western Counties	10,060	17,339
Midland Counties	39,085	44,323
Southern Counties	36,326	111,246
Eastern Counties	—	2,352

From two complete seasons' working of the Scheme two facts are clearly emerging : the first is that there is a growing demand in the schools for information relating to the Empire ; the second is that the volume and the nature of the appreciation expressed by Directors of Education and Head Teachers provide adequate assurance that the choice of lecturers has been sound and that the Scheme is developing on the right lines. Lecturers are carefully chosen and in order to keep their place on the panel they are required to maintain at all times a high standard. The introduction

of new lecturers, particularly Empire Nationals (of all races, colours and creeds) is a process which, though gradual, as it should be, never ceases. The steady expansion of the Scheme is stimulating to the lecturers themselves who derive great encouragement from the obvious and growing desire of teachers and scholars alike, to know more about those parts of the Empire in which the lecturers themselves were born or where they have lived so long, a desire which is fostered by the local Educational Authorities.

A large number of schools are asking for courses of lectures covering the whole Empire by means of weekly or fortnightly talks. These courses are supplemented by the teachers who give special lessons complementary to the lectures. The result has been to give vividness and realism to the study of the Empire.

The expansion of the Empire Lecture Scheme has brought with it problems of finance which at one time threatened to become acute. However, through the generosity of the Leverhulme Trustees, who, for the third year in succession, have given £1,000, the Rhodes Trustees, who have made a contribution of £1,000 and the Committee of the Empire Day Movement who have voted £500 from their funds, the operation of the scheme is assured until the end of the present lecture season, i.e. August 31, 1944. Under an arrangement financed by the Royal Society of St. George, Empire lectures are being given to units of scouts, guides, cadets, etc., affiliated to the Society.

The co-operation of Directors of Education in the Provinces which was noted in the last review of the Empire Lecture Scheme is now becoming an important feature. The arrangements are very simple; on the one hand the Directors of Education arrange programmes of lectures in the schools and on the other hand the Imperial Institute provides the lecturers. The Institute is indebted to Educational Authorities who assist in this way. Not only does it enable the services of the lecturers to be used to the best advantage and at the smallest cost per lecture; but it puts the Lecture Scheme on a right footing with the schools.

In view of this healthy development there is little wonder that the Scheme continues to expand. During the first two months of the current lecture season, September and October, 447 lectures were delivered against 224 during the same period in 1942.

Colonial Visitors.—The following is a list of officers on leave from the Colonial Empire who have visited the Institute during the period June-November 1943:

JUNE

H. W. MOOR, Conservator of Forests, Gold Coast.

W. C. L. ORR, B.Sc., Senior Veterinary Officer, Gold Coast.

E. F. SMITH, Labour Adviser, Jamaica.

REV. R. W. STOPFORD, M.A., Principal, Prince of Wales College, Gold Coast.

JULY

J. N. OLIPHANT, C.M.G., Chief Conservator of Forests, Nigeria.
 MAJOR V. C. SCLATER, Private Secretary to Mr. H. R. R. Blood, C.M.G., Governor of the Gambia.
 G. F. SHARP, Postmaster-General, British Guiana.

AUGUST

R. C. ALLEN, Director of Education, Gambia.
 SIR BERNARD BOURDILLON, G.C.M.G., K.B.E., ex-Governor and Commander-in-Chief, Nigeria.
 F. A. CASSIDY, Inspector of Mines, Sierra Leone.
 H. A. HAY-BARCLAY, Veterinary Officer, Sierra Leone.
 H. H. JEFFERS, Education Officer, Nigeria.
 W. F. JEFFRIES, Education Officer, Nigeria.
 D. M. MACDOUGALL, Hong Kong Civil Service.
 J. C. K. MCELDERRY, Assistant Conservator of Forests, Nigeria.
 F. W. THOMPSON, B.S.A. (Toronto), Master at Achimota College, Gold Coast.

SEPTEMBER

SIR THEODORE S. ADAMS, C.M.G., Chief Commissioner, Northern Provinces, Nigeria.
 A. E. V. BARTON, C.B.E., Comptroller of Customs, Nigeria.
 H. R. R. BLOOD, C.M.G., Governor and Commander-in-Chief, Gambia.
 W. K. H. CAMPBELL, Development Adviser in West Africa.
 J. W. D. FISHER, Senior Agricultural Officer, Sierra Leone.
 DR. G. N. A. HALL, Veterinary Adviser, Sierra Leone and Gambia.
 DR. F. R. IRVINE, Master, Achimota College, Gold Coast.
 K. R. MACDONALD, Assistant Conservator of Forests, Nigeria.
 E. W. MOMBER, Agricultural Officer, Nigeria.
 SIR HUBERT STEVENSON, K.C.M.G., O.B.E., M.C., Governor, Sierra Leone.

OCTOBER

A. H. CLIFT, Principal, King's College, Lagos, Nigeria.
 E. T. HOLMES, Senior Agricultural Officer, Sierra Leone.
 W. C. LESTER-SMITH, Soil Censor Officer, Ceylon.
 J. K. MAYO, Senior Botanist, Nigeria.
 H. R. MITCHELL, Senior Inspector of Mines, Nigeria.
 D. B. MURRAY, Botanist, Nigeria.
 S. SIMPSON, Veterinary Officer, Gold Coast.
 A. L. C. THORNE, Veterinary Officer, Gold Coast.

NOVEMBER

E. H. JAQUES, Geologist, Nigeria.
 A. F. A. LAMB, Assistant Conservator of Forests, Nigeria.

Obituary—P. J. Redmond.—The death on September 5, 1943, of Mr. P. J. Redmond, Assistant Secretary since August 1938, is recorded with deep regret.

Mr. Redmond joined the staff of the Imperial Institute on June 16, 1902, and filled the post of Registrar for many years before assuming the duties of Assistant Secretary. In October 1942 Mr. Redmond was seconded temporarily to the Board of Trade. He was a very keen member of his local unit of the Home Guard, in which he served as Intelligence Officer. In his death the staff of the Institute have lost a good friend and a very pleasant colleague.

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